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THE

MERCANTILE NAVY IMPROVED;

OR,

A Plan

FOR

THE GREATER SAFETY OF LIVES & PROPERTY
IN STEAM VESSELS, PACKETS, SMACKS,
AND YACHTS;

WITH

EXPLANATORY DRAWINGS,

AND

AN APPENDIX,

CONTAINING

THE AUTHOR'S EVIDENCE BEFORE A COMMITTEE OF
THE HOUSE OF COMMONS, IN CONSEQUENCE
OF THE LOSS OF THE ROTHSAY CASTLE.

By JAMES BALLINGALL,
Manager of the Kirkaldy and London Shipping Company,
and Surveyor of Shipping for the Port of Kirkaldy.

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TO

MERCHANTS AND THE PUBLIC,

WHO ARE INTERESTED IN

THE IMPROVEMENT OF THE MERCANTILE NAVY
OF THE UNITED KINGDOM OF GREAT BRITAIN
AND IRELAND, AND HER COLONIES,

THIS WORK

IS MOST RESPECTFULLY DEDICATED,

BY THEIR MOST OBEDIENT

AND VERY HUMBLE SERVANT,

THE AUTHOR.

PREFACE.

I have the kind permission of J. Knowles, Esq. F.R.S. Secretary to the Committee of Surveyors of the Navy, to make such extracts as I may think proper from his very valuable work, "An Inquiry into the means which have been taken to preserve the British Navy;"* and as no language which I can command, would so well apply to the object in view, as that used in his preface, I take leave to quote the following passages from it.

---

* I would earnestly recommend a perusal of this Treatise to all Ship-owners; the information it contains will well repay the price, and it is unnecessary to remark, that from the official situation held by Mr. Knowles, he has better means of correct information on the strength and durability of vessels, individually, collectively, and generally, than any documents kept in the mercantile interest can furnish, notwithstanding the Register Books of Shipping. Mr. Knowles's Treatise should lie on the table of the Reading Room of every Sea-port, which has one.

"To naval and commercial countries, there is no object of greater importance than the preservation of their ships. But to Great Britain in particular, who has long claimed and enjoyed the sovereignty of the seas, and a great proportion of the trade of the world, this is a subject on which her vital interests depend. Sir Walter Raleigh has justly observed, 'that whoever commandeth the sea, commands the trade; whoever commands the trade of the world, commands the riches of the world, and, consequently, the world itself.' The command of the sea is not, however, to be obtained by the number of our ships, or the skill and courage of our seamen alone; it depends also upon the condition and fitness of the vessels which they navigate, and the preponderance of trade is preserved, not by enterprise only, but, by conducting commerce in the most efficient manner, and on the most economical principles. The strictest attention ought then to be paid, to extend the durability, and improve the state and condition of our royal and mercantile navies."

* * * * * * * * * *

"In the proportion that theoretic construction has been neglected, the practical art of building has been encouraged; and hence it is, that the workmanship in British ships has been equal, if not superior, to that of most of those built in any part of Europe. But, for the want of principles, little of alteration or improvement was for many years introduced in the disposition of the materials, or connection of the several parts, so as to increase the strength of the vessels. Within the last ten years,* a new system has been invented and introduced by Sir Robert Seppings, which has given to our ships of war, great additional strength to resist the effects of the waves, is likely to be conducive to their durability, and to ensure the safety of the mariners.

---

* Mr. Knowles's Work is dated 1st January, 1821.

"From the jealousy incident to human nature, in properly appreciating and applying the inventions of others, or the indolence of the mind in not bringing itself to examine new methods or combinations, these improvements, while they have been eagerly grasped by foreign nations, are but slowly introduced in the ships of our merchants, and, with an apathy hardly to be credited, are totally neglected by the first trading company in Europe. Although ignorance of their application, and bigotry to old customs, may for a time prevent their introduction, the evidence of their advantages must in the end prevail."

It is much to be regretted, that there should exist so strong a prejudice amongst ship-owners, of extravagance in the King's dock yards, or in building ships of war. Economy and durability, are and must be as much objects in the King's yards, as in a merchant's yard. Durability in a merchant's yard is at least questionable, since what is for the interest of one party, is against the interest of another.

With respect to any alterations of construction I have presumed to suggest, the Remarks will shew that by far the greater part of them have been in practice in the Royal Navy, for one and twenty years, and that so far as they are in conformity thereto, no objections can lie against the practicability of them, and I must be understood throughout, as speaking of well seasoned wood. Unless this be the case, the fabric must soon decay.

It is due to state, that I have met with the ready attention of the Admiralty, to direct an investigation into the proposal, and that I have at all times received every countenance and encouragement from Sir Robert Seppings, the Surveyor of His Majesty's Navy.

With respect to prejudices in shipping matters, I will only remark, that coppering vessels' bottoms, chain cables, chains for running rigging, solid bottoms to ships of war, and Steam Navigation, have each of them been opposed, and have each of them made their way in spite of opposition. A principle, the effect of which, would be to alter the whole classification of merchant shipping, cannot be expected to be more fortunate. Let its merits or demerits, however, appear for themselves.

In conclusion, I have only further to state, that in this little work I make no pretensions to elegance of style. It has been written, as well as printed, at different times, and, in consequence, there may appear to the critical reader a want of arrangement, and perhaps repetition, which under other circumstances might have been avoided.

Kirkaldy,
20th January, 1832.

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The advantages of the following Plan to the Ship Owner and Merchant are:

1st.—Increased strength to the vessel against collision, and violence of every kind.

2nd.—Increased durability to the timbers, as proved by the experience of twenty-one years in the Royal Navy.

3rd.—Increased safety to vessel, life, and merchandise, in proportion to the thickness of the timbers and ceiling plank, or upwards of four to one, when compared with the present construction.

4th.—Increased protection against fire, owing to the exclusion of air.

5th.—Increased safety to vessel, stores, and merchandise, by the exclusion of vermin.

6th.—Increased comfort to passengers and crew, by the exclusion of bilge water, and noxious air from between the timbers.

7th.—Knowing at all times, day or night, by looking at, or in a dark night by feeling, a marker, or index, on deck, when there is any, and what quantity of water in the vessel.

8th.—A greater vacant space to hold water in than under the present construction, without taking more from the stowage than is prescribed by law, with the power of taking all the water out of the vessel, *and almost a certainty of there being none to hold.*

9th.—No risk of the pumps getting choked, under any circumstances.

10th.—A leak always visible on the inside of a vessel, when the cargo is out, and may be stopped on the inside, without the necessity of docking, or heaving down.

11th.—The ship owner always protected from claims of damages for the vessel not being properly dunnaged to stand survey; and the expense of providing new dunnage, almost every voyage, to Baltic vessels, &c. saved.

12th.—In the event of damage to the vessel, the repairs would be much easier effected than at present, where the kelson, for instance, and the ceiling-plank on both sides, must be lifted, as well as the outside bottom planks removed, to shift a few floor timbers, although broken only on one side.

13th.—Increased stability to the vessel when afloat, by greater weight proportionally, being thrown into the bottom than into the topsides, and consequently requiring less ballast.

14th.—More weatherly at sea, rolling counteracted; and would take the ground better, and list less over upon it, by having bilge-pieces.

15th.—A double, detached, and separate bottom, always in its place, in the lower deck, in the event of damage to the proper bottom, upon which the vessel might be floated, or easier got off a strand or rocks, if she were ashore.

16th.—The greatest defect of all large vessels, viz. arching or hogging, and sagging in small merchant vessels, greatly counteracted by the vessel being better supported and wedged below, and both wedged and tied aloft, in as many places as she had decks, each stringer acting as an internal hoop, each thwartship plank as a beam, and each fore-and-aft plank as a tie, and consequently the whole vessel forming one united, consolidated, and compact body, with each part of the fabric supporting the other.

17th.—The vessel built nearly out of straight wood, with the exception of a few breast-hooks, timbers, and knees, and when requiring repairs, the necessary materials cheaper, and more easily procured.

18th.—In steamers, with water-tight cabin and forecastle, bulkheads and decks, the passengers and crew quite safe, although the boilers should burst, or the vessel was bilged and full of water amidships; and in the event of her separating, the cabin and forecastle might afford safety and shelter till relief could be obtained; and a double bottom would be always in its place, in a platform under the boilers.

19th.—The vessel might with much less risk than at present, be run on shore, in case of necessity, or laid on any safe beach, to clean the bottom, examine, or repair, &c.

20th.—A considerable quantity of molasses, with sugar cargoes, or tar, with tar cargoes, and of grain, seeds, pepper, teas, &c. with those cargoes, which are now pumped out of vessels and lost, might be saved; and much anxiety of mind to the master, and labour to the crew, in pumping, prevented.

21st.—The vessel being very much stronger under the proposed construction, there would be much less damage received in getting ashore, and consequently fewer repairs required; and old vessels, although not made so complete, could be improved so far as to give them a double bottom in their ceilings, at a small expense, which would be much better protected from injury than the outside planking, and which might be the means of preserving the vessel.

22nd.—Besides these advantages, there would be decreased risk to the ship-owner, if he did not insure, and decreased premium if he did, seeing that 25 per cent. of the present premiums are caused by petty damages, proceeding from the straining of vessels, and from vermin.

SUMMARY.

It is the opinion of practical men, well able and competent to judge, that if the plan were adopted, (and it is coming into practice) it would be the means of saving at least one-third, if not more, of vessels, lives, and merchandise, which, under the present construction of merchant vessels, will inevitably be lost. Would not these advantages be cheaply purchased, although vessels' hulls should cost one half more than under the present construction?

DEFINITION of such Terms used in the Theory and Practice of Ship-building, as occur in the following pages; from a *Treatise on Marine Architecture*, by PETER HEDDERWICK, Edinburgh, 1830.

Abaft or *Aft,* towards the stern or hinder part of a ship.

After-body, every part of the hull of the ship which is abaft the midship section.

Afloat, buoyed up by the water.

Afore, the fore part, towards the bow of the ship.

After, the after part, towards the stern.

Amidships, the middle of the ship.

Ballast, any heavy material, such as sand, stones, or iron, &c. placed in the bottom of the vessel, to lower the centre of gravity and make the vessel stable, so as not to be easily canted or heeled over by the impulse of the winds or waves.

Battens, long narrow slips of fir, used for fairing or sheering the ship, or drawing the lines by in the moulding loft. A batten commonly signifies a long narrow slip of wood.

Beams, large pieces of timber extending from the one side of the vessel to the other, for binding her together and supporting the deck. The midship-beam is the beam immediately at the midship-frame.

Bevellings are the different angles or twistings of the edges of the timbers or planks. When the edge of a timber forms an obtuse angle with its side, it is said to have a standing bevel; and if it forms an acute angle with the same side, it is said to have an under bevel.

Bilge, the outer part of a ship's bottom, on which she rests when aground.

Bilge-pieces, planks or keels fastened on the bilge of the vessel, for strengthening that part which rests on the ground. Bilge-keels are sometimes put on the bottom, running in the same direction as the plank, that is, in a fore-and-aft direction, to prevent the vessel from heavy rolling, or from drifting to leeward, and the like.

Bottom, that part of the ship which is below the load-water line or wales.

Breast-hooks, large pieces of timber bolted across the inside of the ship's bow.

Bulkhead, a partition. Bulkhead is the name given to the boards or planks which separate one part or cabin from another.

Butt, is the joining endways of two timbers or planks.

Carlings, pieces of oak, about four or five inches square, let into the beams of the vessel at each end, so that they are straight with the upper side of the beams, and lie in a fore-and-aft direction. Between the carlings are pieces which lie parallel with the beams, called ledges.

Caulking, driving oakum between the seams of the planks, to prevent the entrance of water.

Ceiling, the inside planks of a vessel.

Chinse, to caulk lightly.

Chocks, pieces of wood used for filling up any want or defect. At the joints of timbers cross-chocks are used; these scarph on to each timber, and connect the two together. It has long been customary to cross-chock the joints of different timbers. It has lately been proposed in the navy yards to make the timbers to butt square upon each other, and insert a dowal half into each. This, however, in my opinion, is not preferable to chocking the timbers.

Cleats, pieces of wood of different shapes, nailed or bolted on any particular part of the ship, either for belaying a rope to, or resting a shore against.

Clencher-built, when the planks overlap each other at the edges, and form projections on the bottom. Clencher-built vessels are much stronger, in proportion to their weight, than carvel-built ships.

Coamings, pieces of wood raised round the sides and ends of the hatches, to prevent the water from running off the deck into the hold.

Converting the timber, is the act of bringing it into a fit shape for ship-building, by sawing and hewing it into the form required. It is nothing more than finding the proper pieces of timber to suit the different moulds with the least waste, and is a matter of very great importance to the shipbuilder. I have sometimes found foremen who were good converters of the material, and at the same time very indifferently qualified in other respects for carrying on the building of a vessel. I have also seen persons who were very good draughtsmen, and great wasters of the material.

Cross-poles, temporary beams for keeping the frames at their proper breadth until the vessel is planked, and the proper beams put in.

Dead-wood, certain large pieces of timber fitted on the keel at the stem and stern-post, for the purpose of raising the floor-timbers and bolting to the heels of the cant-timbers.

Decks, the flats which are formed by covering the beams with plank; these run in a fore-and-aft direction, and constitute the decks of the ship. Large vessels have three or four decks, as the lower deck, the main deck, the upper deck and quarter deck, forecastle deck, poop decks, &c. A flush deck is one which is continued from stem to stern of the ship.

Dowals, Coggs, or *Coaks,* cylindrical pieces of hard wood, about three inches in diameter, and the same in length; they are let half into two pieces of wood which are to be joined together. The bolts pass down through the axis of the dowals.

Draught of Water, the depth of water which a ship displaces, either loaded or unloaded. The former is called the load-water draught, the latter the light-water draught.

False keel, False stem, False stern-post, or the like, is an additional keel, stem, or stern-post, fixed on the main keel, main stem, or main stern-post, to increase their strength, and make a ship hold a better wind.

Fay, is to fit close, or join two pieces of wood together.

Filling-in-timbers, are those between the frames.

A Filling is a piece of wood fitted on a timber, to make up a want or defect. The timbers should not have fillings if it can be avoided, particularly on their outside.

Floor, the bottom of a vessel near midships. In the midship body, the flattest part of the floor is at the flat frame marked ⊕.

Floor-timbers, large and strong pieces of timber which extend across the keel; upon these floors the frames are erected.

Flush, is when two pieces of wood are checked into each other, and their surfaces become even. This term signifies a continuation of even surface.

Fore-body, every part of the hull before ⊕, *i. e.* the dead-flat frame, and *After-body* is the hull abaft the same.

Forecastle, a short deck at the bow of the ship.

Founder. To founder is to sink, owing to the quantity of water received into a vessel.

Frame of timbers, in shipbuilding, signifies a number of pieces of timber bolted together, in order to form the bottom and sides of a vessel. It consists of the floor-timber, two first futtocks, two second futtocks, two third futtocks, two fourth futtocks, and one or two long and short top-timbers on a side. The frames are placed at right angles to the keel; some of our naval architects have proposed to put them at right angles to the load-water line, which is not parallel to the keel, when the vessel draws more water at the stern than at the bow.

Garboard-strake, a course of the outside bottom plank next to the keel of the ship.

Grain-cut, is when a timber is formed from a straight piece of wood, so that the direction of the fibre does not follow the curve of the timber.

Gunwale, a plank or wale which runs round the vessel's upper works, a little above the deck. In merchant ships, it is called the covering-board, as it lies on the ends of the top-timbers and the stanchions which support the rail pass through it. The gunwale is also called the Plank Sheer.

Hanging-knees, are those which have one of their arms vertical.

Hatches, openings in the deck, through which any thing is lowered down into the hold. The fore-hatch is near the bow, the main-hatch is commonly in the middle of the ship, and the after-hatch is abaft the mainmast.

Hogging, the bending up of the keel of a ship by the vertical pressure of the water on the flat part of her bottom, or the falling down from the first position of the stem or bow, and stern, from not being sufficiently supported by the upward pressure of the water on these parts in proportion to their great weight.

Hold, that part of a ship in which the cargo is placed.

Hull, the sides, bottom, and deck of a vessel.

In-board, the inside fastenings and bindings, all inside of the gunwale.

Keel, the principal piece of timber of a ship. It extends from the stem to the stern-post, and in a small vessel it may consist of one piece throughout. For those of a larger size, the keel is formed of two or three pieces, which are scarphed together, and laid on the blocks. The other timbers which compose the vessel are erected on it.

Keelson, or *Kelson,* an internal keel, placed immediately above the floor-timbers, and bolted down through every other floor and the keel.

Knees, pieces of timber in the form of a right angle; they are sometimes made of iron, and are used for binding the beams to the ship's sides, the one leg or arm of the knee being bolted to the side-timbers, and the other to the beam.

Laboursome, a vessel is said to be so when she pitches or rolls very much.

Lapsided signifies that both sides of the ship are not exactly alike.

Limbers, an opening between the bottom of the floor-timbers and the garboard-strake, making a passage to the pumps for the water which gathers in the ship.

Mortise, a recess or notch made in one piece of timber, to receive a corresponding projection on another; the projecting part is called the tenon.

Oakum, a material made of old ropes, and used for caulking a vessel.

Pitch, tar boiled to a harder and more tenacious consistency. When cold, it is quite hard.

Pitching, a dangerous rising and falling of a ship's bow and stern alternately, owing to the swell of the sea.

Plane, a surface perfectly straight in every direction.

Plank. Wood much less in thickness than in breadth is called plank; the act of covering the timbers of a ship with this, is called planking.

Plank, Sheer, or *Gunwale,* a name for the covering-boards.

Rabbet, or *Rebate,* a kind of V groove cut along the upper edge of the keel, for the purpose of receiving the edge or end of any planks that are to fit against it. There is a rabbet cut on each side of the after-edge of the main stem, and fore-edge of the main stern-post, into which the ends of the planks butt.

Rents, or *Shakes,* are openings which take place in timber when much exposed to the heat of the sun, sometimes to such an extent as to render it unfit for many purposes.

Ribband-line is one formed by the extreme of a diagonal and longitudinal section of a ship's bottom.

Rolling, the motion of a ship from side to side, occasioned by the action of the wind and waves. This motion is affected in a great measure by the form of the ship, and the position in which the cargo is placed. In the theory of the rolling motion, a ship is considered to vibrate round an axis which passes through her centre of gravity. From the action of the water on the cavity of the ship, if the centre of gravity be high, she will be easily overset by the action of the wind or waves; on the contrary, if it be low near the keel, the stability will be much increased, although the rolling motion will be increased.

Rudder, a machine used for steering a vessel.

Run, a part of a ship's bottom, abaft the mid-ship body, and under the water.

Sagging, the bending down of the keel and body of a vessel at the middle, being exactly the reverse of hogging or arching.

Scantling, the dimensions of a piece of timber.

Scarphing, joining two pieces of timber together, by overlapping the end of one piece over the other, but having both points thinned off, so that when joined they appear as an even surface.

Scuppers, lead or copper pipes, passing through the ship's sides at the decks above water, to allow the water to run off the deck.

Seams, the joints of the planks.

Section, the representation of any solid after it is cut by a plane. The whole art of ship-draughting consists in forming proper sections of a vessel, and reconciling them with each other; the different sections receive their names from the figures which they cut or produce, and from the position of their cutting planes. Thus, a section cutting a vessel perpendicularly, and in the direction of her keel, is called a longitudinal section. If it cut the vessel perpendicularly, but at right angles to the length, it is called a transverse section; because the former may be considered as the conjugate section, in reference to the conjugate and transverse diameters of an ellipse. A horizontal section is one whose cutting plane is parallel to the horizon, and a diagonal section is one formed by a plane, which is more or less inclined from any of these former positions.

Sheathing, thin boards or sheets of copper nailed on the bottom of a vessel, to protect it from worms.

Shiftings of the Planks, a term used for expressing the arrangements of the planks, so that they may overlap one another with their ends, forming a shifting of their butts, and bind the ship. When English plank is used, the shiftings or overlaunchings of the plank is five feet, or five feet and a half; but when foreign timber is used, they are generally made seven feet, and there are always three strakes of plank between butting on the same timber.

Sliding keels, large pieces of wood, made to lower down through the main keel of the vessel.

Stability, the property which enables a ship to stand upright in the water, and also to regain that position when the force which has caused her to deviate from it is removed.

Stantion or *Stanchion,* a support.

Standards, large iron knees fitted between the beams of the upper and 'twixt decks, bolted to these beams and the ship's side. They are sometimes called iron staple-knees.

Stem, the principal timber which forms the bow of the vessel, into which the ends of the bow-plank are fixed.

Stern, the after part of a ship above the counter, and in which windows are made to give light and air to the cabin.

Stern-post, a strong piece of timber, generally extending from the keel to the upper-deck. It fits to the after end of the keel with mortise and tenon, and is fastened by the dead-woods and heel-knee.

Stringers, strakes of planks wrought round the inside at the height of the under side of the beams. They are bolted to the clamps and timbers, and are hook-scarphed. As they are put on edgeways, and serve as a shelf to rest the beams upon, they are sometimes called shelf-pieces.

Timbers, the ribs of a ship; the pieces of wood of which the frames are composed.

Top-sides, all the ship's sides above the bends.

Top-timbers, timbers forming the top-sides.

Treenails, cylindrical oak pins driven through the plank and timbers to fasten them together.

Unship, to remove any thing out of its proper situation on board a vessel.

Upper-deck, the uppermost deck that extends from stem to stern.

Upper-works, a name for that part of the hull of a vessel above water.

Yards, long cylindrical pieces of timber, suspended across the masts to extend the sails to the wind.

THE

MERCANTILE NAVY IMPROVED,

&c.

The following observations are relative to all Merchant Vessels and Steam Vessels, and partially to the Royal Navy of Great Britain, although, from the very great improvements recently introduced into it by Sir Robert Seppings, the remarks do not apply so strongly to it, as they do to the Mercantile Navy, from the largest East Indiaman, belonging to Great Britain, to the humblest class of traders, so far as I am aware, and so far as can be ascertained by recent enquiries at London, Leith, Dundee, and other ports.

It has been the practice hitherto, and, so far as is known, is so still, up to the present time, in merchant vessels, to caulk only the outsides of them, from the keel to the gunwale, and thence inboard over the decks, and to leave the inside plank, commonly called the ceiling, with certain exceptions for strengthening the vessel, uncaulked, and at least to leave an upper water-course, above the timbers, covered with limber boards, which is just the lowest ceiling plank, next the kelson, cut into certain lengths, and reduced somewhat thinner than the adjoining planks, and either suspended or supported level with the top of them, and thereby giving a water-course, equal to the thickness or quantity reduced, uncaulked, and a large portion of the inside planking of the bottom uncaulked, for the purpose of allowing any water which might get into the vessel to find its way down between the timbers, and from thence by the upper or under water-courses to the pumps, the ends of the pumps being carried down between the timbers under the ceiling, and suspended near the garboard strake, or outside bottom plank; also to leave a part of the ceiling unplanked and uncaulked for air.

An under water-course is cut by notching the floor timbers, on the lower part, next the outside plank, or fitting wedge pieces or chocks on the lower part of the floor timbers, which wedge pieces are either hollowed out if the ends of them are brought close down to the keel, or the ends of them are cut off a little short of the keel, and in some vessels, the inside of the bottom plank is not brought close up to the timbers; or a groove or water-course is cut out of the garboard strake, and the ends of the first futtocks are not brought close down to the keel, to allow the water to flow past them to the pumps; in few words, a water-course is left under the timbers, and between them and the outside bottom plank, all tending most materially to weaken the vessel. Some vessels have also an under water-course in the bilges, weakening them still further. The upper and under water-courses are shewn at Fig. 1, Plate 1, being the section of a coasting vessel, at the side of one of the floor timbers.

To shew that the defects in the construction of merchant shipping are well known to professional men, and rest on higher authority than mine, I take leave to quote the whole article "On the Construction of Ships in the Mercantile Navy,"* from the Supplement to the Edinburgh Encyclopedia, vol. 18, pleading in apology for so doing, that I do not believe the defects are thought of by ship-owners in general, and that to point them out is the only true way to have them remedied, and that without expecting any such results to follow my humble endeavours, I am still using my best exertions in a good cause.

"ON THE CONSTRUCTION OF SHIPS IN THE MERCANTILE NAVY."

"There is a serious and important defect in the present construction of mercantile ships, as regards the putting together of their ribs or frames, and the general arrangement of their materials.

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* I am informed this article has attracted great and general attention amongst Foreign Nations. Shall Great Britain, then, allow Foreign Nations to be the first to remedy the defects which she can so ably point out, and show how to be remedied, and to excel us in the structure of their merchant shipping?

" In forming the frames or ribs, *half the timbers only are united so as to constitute any part of the arch;* every alternate couple only being connected together, the intermediate timbers, termed fillings, being entirely unconnected with each other, resting only on the outer planking, without contributing in any degree towards its support. It must be evident that ships so constructed can by no means possess equal strength with such as have the whole of their timbers formed into uniform frames or arches.

" This loose, dangerous, and very imperfect mode of shipbuilding, is, according to Sir Robert Seppings, peculiar to the English merchant shipbuilder; and we know even that it is only in latter years that the same system of building has been abandoned in the king's dock yards, while the preferable system of connecting the ribs was common to other maritime powers.

" The principle of uniting the frames, lately introduced in the construction of ships of war, might, without doubt, be advantageously introduced into the mercantile navy; a system which would communicate to the ships of our commercial marine much additional strength and increased durability, *without adding to the expense of building*.

" But the present mode of joining together the several pieces of the same rib, is open also to the heaviest objections. The method adopted is by introducing a third piece, technically termed a *chock* or *wedge piece*, as in Fig. 1, Plate D. of which pieces the number amounts to upwards of 450 in a 74 gun ship, and to not less than that number in an Indiaman of 1200 tons, and to which class of ships the subsequent drawings to be referred to have an especial reference. Of these chocks, not one in a hundred is ever replaced on the general repair of a ship; for they are not only found defective, but very generally to have communicated their own decay to the timbers to which they are attached. Besides this, the grain of the rib pieces being much cut to give them the curvature required, contributes in a very considerable degree to the general weakening of the fabric. That they occasion a great consumption of materials is very obvious, as the ends of the two rib pieces must be first cut away, and then replaced by the chock.

" The introduction of chocks was done with the view of obtaining that curvature which is so necessary in the formation of a ship, when crooked or compass timber became scarce, as may be seen by a reference to Fig. 2. which describes the shape of a piece of timber in the converted form; and by which also it will be perceived that the introduction of the chocks assists in obtaining the required curve.

"The frames of a mercantile ship, on the present mode of building, before they are placed and united to each other, may be seen in Fig. 3, with their chocks or wedge pieces. To the evils already stated of the present practice, may be added that of imperfect workmanship, so that the surfaces of the chocks are seldom in contact with the surfaces of the timbers. The ends of both are moreover frequently reduced so thin, as to split by the fastenings that are necessary to secure the planks to the ribs; and thus the ship, in the event of grounding, or even in the ordinary act of rolling, derives little support from timbers united only in fact by two narrow edges.

"Another great defect arising out of the present plan of constructing mercantile ships is, that the ends of the lower ribs or timbers, commonly termed futtocks, Fig. 3 B, are not continued across the keel C, so that no support is given in a transverse direction when the ship touches the ground; nor any aid to counteract the constant pressure of the mast. This great sacrifice of *strength* and *safety*, is made for no other purpose than that of giving a passage for the water to the pumps.

"The floor timbers, which by this mode of construction are the only timbers which cross the keel, are also weakened for the same purpose, as shewn at D in the figure last quoted. This mode, moreover, makes the conveyance of the water very uncertain, since the passage is not unfrequently choked; and the pumps from its not being practicable to continue them sufficiently down, always leave from six to eight inches water in the ship; so that these compartments constantly contain a certain quantity of putrid bilge water, offensive and injurious to the health of those on board.

" The deficiency of strength causes also an alarming insecurity in the plank of the bottom, termed the garboard strake, as shewn at E; and which consequently is in no other way connected with the general fabric, than its connexion with the keel at F, and a slight security at G. Hence it is obvious, that in the event of the keel being disturbed, the garboard strake, from its being attached to it, must share the same fate as the keel, and in that case the loss of the vessel would be inevitable.

" To obviate these very serious defects, and to do that for our mercantile marine which he had already so successfully accomplished for ships of war, Sir Robert Seppings laid before the Royal Society in March 1820, a highly important paper, and which was printed in the Transactions of the same year. The principle may be comprehended by a reference to Fig. 4, in which it will be seen, *that the component parts of each rib are of shorter lengths and less curvature, and consequently less grain cut; that they are more firm and solid by the substitution of coaks or dowels, for chocks or wedge pieces; and that the mode of connecting the lower timbers is better adapted, in the event of a ship grounding, to give support and strength to the fabric, as will appear by the line marked H.*

" That the frame of the Thunderer, (now the Talavera,) built on this principle, is superior in point of strength, says Sir Robert Seppings, to a frame constructed on the common system, is fully established by a report from the officers of His Majesty's yard at Woolwich to the Navy Board, who directed them to compare the strength of the frames so united with those of the Black Prince, constructed in the usual way with chocks or wedges.

" In alluding to this interesting and important comparison, Sir Robert remarks, that '*the frame of the Thunderer was composed of small timber, hitherto considered applicable only for the frames of frigates.*' 'I was prompted,' says this ingenious constructor, 'to attempt the introduction of the plan on which she is built, from there being a surplus store of small timber in the yard; and from a conviction, *that a well-combined number of small timbers might be made equal, if not superior, both in strength and economy, to the large, overgrown, and frequently grain-cut materials, made* *use of in constructing the frames of large ships; and the result has shewn the correctness of the principle;*[*] the adoption of which cannot fail to prove of great national advantage, *in the application of sloop timber to the building of frigates, and of frigate timber to ships of the line*, whenever larger timber cannot be procured. On this principle, also, may frigates and small ships of war, or merchant vessels, be built of straight fir, without the assistance of oak or elm, which were formerly employed to give the necessary curvature of the sides.' The principles here laid down by Sir Robert Seppings, are of vast importance, and we earnestly hope will speedily and generally be adopted.

"As it respects the general safety of the ship, it will be seen by a reference to Fig. 5, Plate D. and Plate DI. that the timbers uniformly cross the keel; that the frame of the ship is filled so as to form one compact body to the height marked K; and that only certain internal strakes of planks, or thick stuff, as it is termed, are introduced, which are those on the joints of the timbers, for the purpose of giving strength where every alternate timber necessarily joins, as shewn at L.

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[*] "A just economy of materials should be one of the first objects of the builder's attention, and this desirable object is to be obtained only by judicious combinations of the materials to be used."—See the valuable work of Mr. Tredgold on the Elementary Principles of Carpentry.

The rest of the inner planking may be omitted, and dunnage battens brought in a perpendicular direction upon the timbers *between* the plank, as shewn at M, forming regular spaces between each, as is usual at present, *upon* the plank; thereby giving an increase of stowage in proportion to the thickness of the plank omitted. Water-courses, as shewn by dotted lines at N, are to be left in the joints of the timber under the plank, for the purpose of conveying the water to the pumps; which, by this plan, will reach below the water, instead of being some inches above, as is the case with the present mode, before described. Consequently, by the proposed system, no stagnant water will remain; and farther, the limber passage, or water-course, will be one smooth uniform channel, which can be cleared with ease, should it be required, whenever the hold is unstowed; whereas at present it is inaccessible in places, and forms compartments for putrid water, without there being any means of removing it.

" It is obvious that a ship constructed on this principle, may sustain the loss of certain planks of the bottom, and also the keel, (which has frequently been found to have happened to ships of war on their being taken into dock,) and still reach the place of her destination, when the loss of *either* would be the destruction of a ship built on the present mode. It will be evident also, that a ship constructed as now recommended, possesses greater stowage and more space for leakage than by the old plan, by the omission of the useless inner planking, and by laying the kentlage on dunnage, leaving a space for the water, which was formerly occupied by the inner lining. This dunnage in the bilge may be found in the iron kentlage, and thereby serve as ballast, for which it is well calculated from its situation, and by its occupying a space heretofore forming part of the fabric of the ship, will give an increase of stowage, as before stated.

" The best method of closing the openings between the timbers, is by filling the intermediate space with pieces of wood, about three inches in depth, of such lengths as the inferior conversions will supply, abundance of which may be procured from the offal. These fillings are to be well caulked, after which the exterior plank is to be brought on. When the works are going on within board, similar pieces are to be fitted internally, and afterwards taken out for the purpose of filling the spaces between the pieces so fitted with a mixture of Parker's Roman cement and drift sand, in the following proportions, viz.

Parker's Roman cement,	$\frac{2}{3}$
Drift sand, . . .	$\frac{1}{3}$

previously paying the opening well with coal tar. Where there is sufficient space, a brick, or part of one, may be introduced, provided there is room for cement between it and the timbers. When filled in to within about two inches of the surface of the frame, the pieces of three inches already fitted and taken out, are to be well driven in and caulked, and by so doing, no space will be left unoccupied. If considered desirable, these pieces may be driven below the surface of the timber, thereby leaving water-courses to convey the leakage to the pumps in channels. And prior to launching or undocking of ships built on this principle, it has been the practice to inject the part filled in with mineral tar by means of a simple forcing pump, boring holes in the joints of the timbers for the introduction of the pipe. By following this method the air will be excluded, which, as experience has shewn, tends much to the durability of the fabric. If what is here recommended be attended to, says Sir Robert Seppings, and mercantile ships were built under roofs, as ships of war now are, durability would be obtained in addition to safety from the mode of their construction.

" The beams are to be attached to the sides, as shewn at O, Plate D, Fig. 5, rendering wood knees unnecessary, and requiring only a small number of those of iron.

" Plate DI, Fig. 1, marked P, describes the old principle of framing the stern with transoms. Q represents the new principle, with timbers similar to the bow, omitting the transoms below the wing or upper transom; and by introducing the new principle on which the floors are made, the necessity of using valuable compass, or crooked timber, hitherto required, and with difficulty procured for these purposes, is avoided. Uniform support will thus be given, and also an increase of room for stowage.

"In large mercantile ships above 500 tons, Sir Robert Seppings would recommend that plate iron be laid diagonally, as shewn in Plate DI.

"The principle thus recommended will cause a decrease in the consumption of materials, and the difficulty of procuring the necessary curvature will be obviated. It also affords protection from worms externally, and vermin internally. Leaks may be more easily discovered and stopped than by the old method; and in point of additional strength there can be no doubt. If farther proof were required, Sir Robert Seppings refers to the case of the Malabar of 74 guns, built at Bombay, and which arrived at Portsmouth, loaded to her upper deck with timber, and during her passage encountered four heavy gales of wind, without shewing a symptom of weakness, as will appear by the following extract from the survey made by the officers of the Plymouth yard, on that ship, by order of the Lords Commissioners of the Admiralty.

" ' When we consider the nature of the lading that this ship has brought home, with the temporary security to the beams of all the decks, except the orlop, and that on her passage she encountered four very severe gales of wind, it must, we presume, be very gratifying to your honourable board to find, that she does not indicate any past symptoms of weakness or straining in any part.'

" This ship had no other attachment for her beams than the internal hoops and thick water ways; the remainder of her security, the iron knees, being omitted (from the difficulty of procuring them in India) until her arrival in this country; thus supporting her cargo without the aid of knees, either of wood or iron."

The construction of the water-courses is of more consequence than at first sight may appear. It is well known that many vessels have been lost owing to their pumps having got choked, and become thereby unserviceable; and as sand ballast is of all substances which a vessel takes in, the most difficult to be guarded against from choking the pumps, I shall take it as a representative for grain, seeds, coal-dust, or any other substance whatever, which would choke them.

Without entering into the details of practice of caulking the ceiling as high as the top ot the sand ballast which is to be taken in, and chinsing the limber-boards and seams of the pump well, it is certain they must either be caulked or not. If they are caulked, which is the general practice, and water gets into the vessel aloft, for instance, at the hatchways, not a drop of this water can get to the pumps to be pumped out, and as it is not customary to caulk the ceiling much higher than the top of the ballast, when the vessel is heeled over, and water gets *within* the ceiling, at either the weather or lee side, the same thing happens, and a vessel may thus be foundered without the possibility of the pumps taking a drop of water out of her, owing to the bottoms of them being carried below the ceiling.

Again, if the ceiling, limber-boards, and pump well are not caulked, and water gets into the vessel either from above or below, it washes the sand down at the seams of the ceiling planks, or limber-boards, and chokes first the water-course under the timbers, (as is well known in practice,) then fills up the vacant spaces between the timbers, and chokes the upper water-course, and then chokes the pumps in the well, or perhaps more summarily, if the water be high enough, washes the sand in at the seams of the well, and chokes the pumps at once.*

It is quite clear therefore, that whether the ceiling, limbers, and pump well be caulked or not, the construction is equally defective for the double purpose of admitting water from above and from beneath, and keeping back the sand; nor does caulking the ceiling and pump well up to the upper deck, as with a cargo of seeds or grain, remedy the defect, as in this case, with water in sufficient quantities from within, the vessel must inevitably founder, as it could not get to the pumps, with their bottoms below the ceiling; and with a leak from without, as the water would be prevented by the ceiling and pump well from getting into the vessel, she would undoubtedly be safe, as the water, although not pumped out, would only find its level on the outside, if indeed it rose so high, being resisted by the air confined between the outside and inside planking, and gunwale, and deck over the pump well, supposing all these spaces above the leak to be air as well as water tight, though this is hardly to be expected.

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* The disadvantages of open ceilings are well known to those who break up vessels, as shingle ballast is frequently washed down between the timbers, and rests on the inner part of the outside bottom plank, and by the rolling of the vessel, assisted by the bilge water, has been found frequently to have chafed a three inch bottom plank nearly through, besides the risk of choking the pumps. The same thing has happened by shot or other heavy substances having been dropped down at the air spaces or when the limber-boards were lifted, and having rolled from side to side with the motion of the vessel.

By the mode in which vessels in the merchant service are at present constructed, when water is once past the outside planking, it is so far into the vessel, that it must either be pumped out, or if it continues to flow, and is not pumped out, the vessel will sink; and we have a very recent instance of this at London,* as appears from the following extract from the Globe newspaper, of Thursday evening, 17th March.

" *Sinking of a Collier.*—On Tuesday, 15th of March 1831, about one o'clock, a collier brig, the " Spring," laden with a cargo of coal from Sunderland, was moored off Rotherhithe, when owing to the squally state of the weather, she was driven upon her anchor with such force that it protruded through the outer sheathing, and a large hole was pricked in the bottom of the vessel. She filled with water so rapidly, that it was found impossible to save her, and the captain and his crew only escaped just before she went down, leaving her masts only visible."

Here then is an instance, within two miles of the Royal Exchange of London, and Lloyd's Coffee-house, the emporium of commerce, and of the Mercantile Navy of the World, of a vessel sinking and obstructing the navigation of the river, from the simple circumstance of having been driven on her anchor, the case happening to vessels, more or less, every day, of grounding or being driven on their anchors, without seeming to excite any unusual sensation, or instigating any enquiry how a similar disaster may be guarded against and prevented in future.*

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* These remarks were written in April 1831.

The Agamemnon, 64, was lost about the year 1809, in the River Plate, owing to having grounded on her anchor; and there are instances of loss daily, owing to similar causes, or vessels getting damaged in their bottoms on rocks.

It is plainly demonstrable that all water which gets into a vessel, must get in, either from the outside, up to and including the gunwale, or by the inside, including the decks, hatchways, and any openings of any kind in the decks; and if it be in sufficient quantities, it must either be pumped out, or the vessel will sink.

It would appear therefore, that properly securing to the timbers and caulking the ceiling, or inner planking of the vessel, and making it thoroughly water tight, planking over also and thoroughly caulking the whole space at present left for a water-course above the timbers, and covered with limber boards, and caulking the spaces at present left open for air, would afford a double security against a leak as high as the upper deck; but if this be done, how is any water which may have got into the vessel from inboard, to get to the pumps to be pumped out? As matters at present stand, this is plainly impracticable, with the bottom of the pumps carried below the ceiling, and all made water tight above them.

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* On asking a Waterman in September 1831, to point out the spot where the collier brig had sunk, by being driven upon her anchor, in the spring of the year, he enquired, " which on 'em, sir," as if the thing was of such common occurrence that he was at a loss to know which of them I meant.

To afford then a double security against a leak, I would propose to plank and secure the whole inside of a vessel, and fix a cistern under the bottom of the pumps, (or put in a pair of spare pumps, with a cistern under them,) and to plank the present water-courses above the timbers, with plank of a sufficient thickness to bear caulking, and then to thoroughly caulk the whole of it so completely, that although the whole outside planking should be stripped off, the vessel would swim as safely on the ceiling plank, as she does at present on the outside plank. Also to plank and caulk the spaces at present left in the ceiling for air. The method of securing the ceiling to the timbers to be afterwards described.

I would now propose a water course to be led alongside the kelson on each side, as far forward and aft as may be required from the spring of the vessel, raised above the level of the adjoining ceiling, by what I would call percolators, and the bottom of said water-course sunk at least an inch and a half or more below the level of the adjoining ceiling, to allow any water which might get into the vessel to drain dry off the ceiling into this water course. There should be a gradual acclivity forward and aft to cause the water to flow readily along the water courses to the bottom of the pumps. This would be greatly assisted by the spring of the vessel.

In men of war, East and West India ships, and in general, in all vessels which either carry no cargoes, or their cargoes in packages, these percolators may readily be made of strong and thick oak battens fastened to the ceiling close to the water courses, and raised, say 4, 6, or 8 inches high, above the ceiling, with notches cut in the under edges or sides of them, and bored with auger holes, to allow any water to flow freely off the ceiling into the water courses, similar to, I believe, the present practice in the Navy. These water courses to be covered with limber boards as at present, and the boards would not be required to be tight on top; the boards to be sloped up to the kelson. Fortunately in this, the largest and most important class of vessels, all that is required is to preserve a clear space for the water to flow in, unoccupied by iron ballast, cargo, or any other article, and to conduct the water uninterruptedly to the pumps; these vessels having in general thick ceilings (except ships of war, which have no ceilings,) which would afford sufficient thickness of plank, after being thinned or cut down at the water courses, to bear caulking, and strong enough, if occasion required, to float the vessel; the bottom of the water courses to be sunk two or three inches under the level of the adjoining ceiling.

Such vessels as whale ships, timber ships, stone ships, &c. whose cargoes would not damage by immersion in water, need not care whether they preserved a clear and uninterrupted water course above the ceiling or not, provided there was a declivity and water passage from all parts of the vessel's hold, to the foot of the pumps, as in the event of water getting above the ceiling, it would soon find its level, or in other words, its way to the bottom of the pumps. With cargoes of tar also, a vessel would not require to have percolators. This has been held out as a cargo opposing insuperable objections against a plan of this kind, on account of the tar leaking out of the barrels and clogging the percolators: I cannot, however, see the difficulty. In a case of this kind, either lift the percolators, (to be afterwards described,) altogether, if the vessel was already fitted with them, or cover them completely up, either inclosing them with wood and caulking it, or covering them up with so many plies of tarpaulin that the tar would not penetrate it. Now make the pump well thoroughly tight to the height of three or four feet above where the top of the tar could by possibility come to, supposing the whole ground tier of it to be leaked out of the barrels, and part of the other tiers also. Then take a few boards off the pump well, or leave all the space above this open for water, which if it got into the vessel would float on the top of the tar, to find its way into the well. There would thus be water only to pump out of the well, if it was in the vessel, instead of water and tar mixed together choking the pumps as at present.

This tar would make an excellent preventive against a leak from the outside, as high as the level of the top of it on the inside of the vessel. It would also be an excellent coat for filling up all rents, pores, shakes, or crevices in the ceiling, and nourishing the wood of it. It might be necessary to have a water-tight, or rather a tar-tight partition, run all the way fore and aft in the hold, by the midship stantions, (or more partitions if necessary,) to prevent the tar which was out of the barrels, after it had risen above the kelson, from flowing over to leeward, when the vessel was heeled over, similar to the partitions in the vessels called tanks, which bring water in bulk from Rock Fort, to the men of war, at Port Royal, in Jamaica. If these vessels can carry fresh water in bulk, through salt water, which if mixed with it would render it useless, what is to prevent a vessel with a thoroughly tight ceiling, bringing home a cargo of tar in bulk from Archangel or elsewhere? The water would not mix with the tar to destroy it, nor even penetrate it. Keep the tar from leaking outboard, and there is sure to be a tight ship and a well nourished ceiling. Barring such violence as would destroy the vessel under any construction, the pumps might be left at home till next voyage. Of course I am supposing the ceiling and all under it to be tar-tight, and I am not recommending such a plan, but speaking of the practicability of it.*

With merchant vessels carrying their cargoes in bulk, such as coals, grains, seeds, or any loose article whatever, and including river or sand ballast, there is considerably more difficulty, from the certainty that, with only such a protection to the water courses as above-mentioned, if water should get into the vessel, it would wash the articles to the foot of the pumps, and soon choke them.

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* In tight West Indiamen it has sometimes been the practice to send the molasses drained from the sugar, and which was inevitably mixed with bilge water pumped out of the vessels, ashore to be distilled into rum, and I have known a puncheon and upwards, to be produced in this way, while the ship was taking in her cargo. If the whole drainage of a cargo of sugars which is now pumped out and lost, was saved, unmixed with salt bilge water, it would amount to a considerable sum in value.

It is in all cases easier to point out defects than to remedy them, and I am quite aware that owing to the decreased value of shipping generally, the present is not the most favorable time to point out either defects or improvements to the ship-owner, or to shew him the way to expend money on his property, however much it may encrease the value of it, or however obvious may be the improvements. I will, notwithstanding, proceed to show how, in my opinion, such an obvious case as that of the "Spring," may be guarded against in future; and I here intentionally select a most unfavorable case, in, I presume, an old vessel, and for my purpose, of a defective construction. If what I am about to recommend, be found practicable with old merchant vessels, carrying their cargoes in bulk, there will be no difficulty whatever, with any description of vessels building or to be built.

I beg leave to premise that I here restrict myself, not to what I consider best in all respects to be done in the case, but to what alone can be a recommendation to the ship owner, viz. how the thing is to be done at the least expense. But I must first digress, to refer to the practice of building introduced into the Navy, in 1810, by Sir Robert Seppings, and which consequently has been one and twenty years in use. The following is a quotation from the supplement to the Edinburgh Encyclopedia before referred to.

"A solid bottom being a principal feature in the new mode of ship building, not only to give strength to the fabric, but also security to the seamen in case of accident to the plank of the bottom, by striking upon a rock:* this operation is carried into effect by filling the smaller interstices between the lower timbers, as high as the floor heads, with strips of wood, and thence upwards, by driving firmly in the openings between the frame timbers, on the outside, pieces of oak three inches thick, until they make a fair surface with the timbers; on this is placed a composition formed of two parts of lime of a particular description, called Parker's cement, and one part of drift sand, the mixture is placed on the outer filling of wood, until it comes within two inches and a half of the surface inside; an inner filling of oak, similar in all respects to the outer, is then placed on this, and by being driven firmly against the cement, forces it into all the interstices, and thus renders the bottom, to within three inches of the plank under the orlop clamp, one solid mass. The fillings are then dubbed fair, and slightly caulked on one of their sides, and well rammed and caulked on the other."*

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* What gives security to the seamen of a ship of war, would give security to the seamen of merchant ships, and would also *give security to their cargoes.*

Although it be contrary to the almost universally received opinion amongst nautical men,

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* "Ventilation is with difficulty accomplished in the hold of a ship, and the openings which were formerly left between the timbers were filled either with deteriorated air, filth, or the larvæ of insects. Some doubts were entertained when the present system of ship-building was introduced, whether the timbers in the hold, when filled in, would not be subject to premature decay; but this objection, which is contrary to theory, has been proved by experiment, to be totally without foundation; for when the Tremendous and Ramillies, re-built upon this principle, were opened for examination, the timbers which were filled in, were perfectly sound, while many of the others were decayed in their topsides."—*Knowles on preserving the Navy, pages* 63 *and* 64. Reasoning from a part to the whole, the same exclusion of air which preserves a vessel in the bottom, should preserve her in the topsides, and it is the same principle upon which an Egyptian mummy is preserved.

"The evil arising from openings in which air cannot freely circulate was shewn in the renewal of a practice which prevailed in the Navy at the early part of the eighteenth century; that of cutting small scores or channels on the faying surfaces of the timbers and planks, and which was called 'snail creeping'; this had been practised on the Royal William, rebuilt 1719. But when recently carried into effect in Chatham yard, it was found that the interstices so formed, were in a short time full of fungus."—*Knowles on preserving the Navy, page* 65.

Are not the same ill effects produced on a larger scale, in the openings between the timbers where the air cannot freely circulate? The air does not circulate freely in the corner of a wood, and the ill effects are evident in the stunted growth of the trees. If the air cannot circulate freely in the corner of a wood, how much less so must it circulate between a vessel's timbers, where, correctly speaking, there cannot be a circulation of air, if the outside planking be tight, as it ought to be?

I am informed that the solid bottom has not the effect to make vessels sail worse than the old construction, and it may be added, that all vessels are found to sail better when they are new, and their fabrics firmly bound together, than they do when they are old and loose, even although when they are old they have had new copper, new sails, &c. to put them on an equal footing. The action of the rudder, which stops a vessel's way, is merely throwing her out of line. The fastest swimming fishes too, are all of a rigid fibre, as porpoises, dolphins, &c.

I will, therefore, suppose the "Spring," to be raised and taken into dock.

I would then recommend her whole outside bottom planking, from the keel up to and above the bilges on both sides, and the inside planking or ceiling, from the kelson up and opposite to the same height, to be clean stripped off, the kelson to be lifted and triced up out of the way, and the under water-courses in the floor timbers to be filled in. I would also recommend the ends of all the first futtocks, and also the filling in timbers, commonly called first futtocks,* to be extended across the keel, till they met where they should be joined at both ends, and thus convert them into floor timbers. Under the part intended to place the pumps, put in as many floors as would make a solid body of wood.

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* Futtocks, or foot-hooks, get their name from being hooked or fastened to the floor timbers. The filling-in timbers are not hooked or fastened to any thing.

I would now proceed to fill in, with pieces of timber of a proper size, all vacancies between the timbers, and caulk all the spaces between the frames, floors, futtocks, filling-in timbers, &c. outside and in, as recommended by Sir Robert Seppings, and fore and aft, so that when all was complete, the floors and timbers, should present a solid body impervious to water;—any decayed timbers, of course, to be taken out and replaced;—and, in few words, make the bottom timbers where the plank is stripped off, so tight, that if the vessel was taken out of the dock, she would float upon her timbers. Now replace the bottom plank, together with the inside planking, and caulk them both, so that each of them separately shall be thoroughly tight, including the water-courses, which should be kept a little under the level of the adjoining ceiling, and which will now be above the timbers instead of under them, and also caulk the spaces formerly left open for air. When all was complete in a solid compact body, replace the kelson.

It is now evident that, from another similar accident, the vessel would not sink, because suppose her to have been driven upon her anchor on any part of the solid bottom, and even between any two of the original timbers, the solid body which would in that case be opposed to the anchor, would either have broke, bent, or sunk it deeper into the ground, or heeled the vessel over before it would have pricked a hole in her bottom. If it had happened opposite to a timber, the chances of which in a vessel prepared in this way by uniting the futtocks and filling in timbers, would be much increased, it is most improbable that it would have pierced a hole, unless indeed it had happened to hit exactly on a butt of the outside bottom plank, and although it had pierced a hole, the water would not have got into the vessel. Again, if the vessel was pricked by the anchor, above the solid bottom, through the outside planking only, the water would find its way to the doubling of the bottom, where it would be stopped by the fillings, &c. from getting into the vessel, supposing the ceiling from end to end of her to be caulked and thoroughly water tight, as I conceive it ought to be, from the kelson to the gunwale.

Admitting now for argument's sake, *(but bearing strongly in mind, that with two additional defences against water getting into the vessel, it is only admitted for argument's sake,)* that water does get into the vessel from any cause whatever, in large quantities, and the vessel to be loaded with small coals in bulk, and which, if washed to the pumps, will soon choke them, how is the water to get to the pumps to be pumped out, and the vessel preserved, since it is evident from the nature of the water-courses above-mentioned, they will afford little or no protection against the pumps being choked in this case?

To provide against this, and all similar cases with cargoes in bulk, I would fix percolators of the following description.

DESCRIPTION OF PERCOLATORS.

Take oak or elm battens five inches wide, three inches thick, and about six feet long, to adapt readily to the spring of vessels, and bore holes to bolt them to the ceiling at every eighteen inches distant, or thereabouts.

Then bore holes of a quarter of an inch diameter at about half an inch distant, leaving a perpendicular space opposite to where the bolts are to be driven unbored, as shewn in Fig. 1 in the drawing, Plate 2.

Now take strong sheet copper, or sheet lead, (in a model on a working scale, which answered very well, I used sheet copper,) and drill it full of small holes for the water to percolate through, like a percolator coffee pot, as shewn at Fig. 2.

Fasten this copper or lead on top of the batten with staples and wooden pins, the batten being rabetted out of a proper depth to receive it. Turn it down over the face of the batten, and turn it up over the ceiling plank, and fasten it to the ceiling in the same way, with staples and pins, as far as the guard, as shewn at Fig. 3. Fastening the copper to the batten and to the ceiling with staples and pins, is for the convenience of lifting it to be cleaned, if necessary, or for repairs.

For the main percolators, cover the whole, from the kelson to the guard with two inch plank, having a piece about two inches wide fastened to the kelson, with screw bolts and hinges to lift like the lid of a chest, as shewn in Fig. 4, Plate 3, and which may be removed when necessary, to caulk the bottom of the water-courses, which should be of one and a half or two inch plank, well nailed on to the top of the timbers; the hinge joint to be tight.

Fasten down the outside of the lid with strong wooden or metal buttons, flush with the top of the guard. These with the hinges will prevent the top from rising, in the event of pressure by water from beneath, as shewn in Figs. 4 and 6.

The guard to be about four inches distant from the percolator, and to be a plain batten about three and a half inches thick, and of the same height as the top of the lid, and the use of it is to protect the copper from damage by shovels, &c.

in taking out ballast or a grain cargo, and to bear off the weight of the ballast, if the quantity be large, from compressing the percolators too much, so that they might not act. It would also be useful for protecting the percolators from damage by violence, and strengthen and support them in every direction (and also the vessel), and serve also to confine the top of the water-course down as just mentioned.

The guard outside of Figs. 3 and 4, Plates 2 and 3, shews a representation of it, and vacancies should be left on the underside of it about six inches wide for the water to flow freely into the percolators; in short, the battens or percolators formerly mentioned for men of war, East and West India ships, &c. would make very good guards of themselves.

The space between the guard and percolator to be filled with the refuse of tanner's bark, charcoal, small stones, washed gravel, or shingle ballast, small coals, or such substances as would allow the water to flow freely through them, and keep back sand. With a grain cargo these substances would not be required.

I would thus have a space in the water-course of six inches by eight, clear of interruption, excepting the space occupied by the bilge pipe, as shewn at Fig. 4, supposing the batten to be five inches deep, ceiling three inches thick, and water-course six inches broad. These dimensions might be altered, if found either too small, or too large.

A piece of board, of about an inch thick, full of holes, for the water to flow freely through, with a circle cut out of the lower corner next the kelson, for the bilge pipe, should be placed about every six feet distant. The use of this board is, first, to keep the bilge pipe in its place; secondly, to support the ends of the percolator against a side pressure; thirdly, to support the top of the percolator against pressure from above. It should be grooved into the percolator, opposite to where a bolt is driven, and also into the kelson, for unshipping when the top of the percolator is taken off, and when it may be necessary to caulk the water-course. This is not shewn in the plate.

Letter F, Fig. 4, shews the method of leading the bilge pipe out of the water-course, and down into the well prepared for it, at the bilge, and the pipe should be covered in, to protect it from damage.

G, Fig. 4, shews the top of the main percolator half opened, and the opposite side shut. When all is complete, it will much resemble an oblong snuff box, full of small holes in front, as shewn at Fig. 3, Plate 2. Fig. 6, Plate 3, shews the top of the percolators when the lid is shut.

The lines drawn across the keel in the drawings, half way down, Figs. 4 and 5, shew, that in the event of damage to the keel, the bottom planks would be still safe, and the inch and half plank laid under the kelson, throws the outer edge of it into the middle of the water-course for the convenience of caulking, if a new vessel was to be built on this construction, but a water-course might be fitted to an old vessel, (afloat indeed if necessary), which would be perfectly secure.

As before said, percolators would seldom be required in large vessels; but if they were, both the percolators and guard might be made out of the sister kelsons, and there cannot be a question of the strength they would give to all vessels which required them, by multiplying the support to the timbers, which is now received only in one place, from the kelson alone. These percolators to be carried as far forward and aft as the present water-courses are.

As the ceiling would be set hard also by the caulking, from the kelson to the covering board, it would support the vessel very much in a transverse direction, and as the bottom of the water-course would now be in one plank, it would support the vessel in a fore and aft direction, instead of the limber boards loose both at sides and ends, as at present in practice.

Having thus described the percolators and water courses, fix the main pumps as follows:

Instead of carrying the bottoms of them down between the timbers as at present, (the vessel being all solid in the bottom, there would now be no room to do so,) cut a mortice out of the top of one or more of the timbers, and all the way across under the kelson, and a few inches beyond the bottom of the pumps the side way, and if the timbers should be twelve inches deep, cut the mortice down eight inches from the top. In building a new vessel, part of a timber or timbers might be left out instead of this mortice. Now make a cistern of inch thick wood exactly to fit this mortice cut out of the timbers, and fitted to the round of it above and below, and line it with sheet lead, about one-eighth of an inch thick; leave enough of this lead at top to over-lap at least six inches all round, and nail down to the ceiling.

This cistern will now form the only passage for the water from side to side of the vessel, until it overflows the kelson, as shewn at Fig. 5, Plate 3.

Now fix the pumps as formerly, suspending them about two inches above the bottom of the cistern, to guard against accident from the vessel hogging, &c. There would thus be three securities against a leak, instead of only one as at present, at the foot of the pumps as well as over all the rest of the vessel. As the pump well would be tight, no percolators would be required within it. The bottom of the cistern would be ten inches from the top of the ceiling to take the water out of the vessel, if the ceiling was three inches thick.

A float, made either of a piece of cork or a piece of board, to fill the vacant space in the pump well, at the foot of the pumps, with a long small piece of wood as a marker fixed in the end next the pump, and loosely attached to it, and continued up above the upper deck, where the side of the pump should be marked in inches, would always rise or fall with the water in the vessel, and always shew on inspection at the deck, the quantity in her; and as this marker would be covered in with the pump, it would be protected from damage. One of these to be attached to each pump, and as it would be confined loosely within the well, it would act, although the vessel was nearly, if not wholly, on her beam ends. This is not shewn in any of the drawings.

If a vessel had in sand, or river ballast, or other substance of a very small grain, it might be necessary to cover the percolators with flannel, fear-naught, baize, worn canvas, bass mattings, old blankets, hair cloth, or any thing of a similar nature, pervious to water and impervious to such substances: but in the generality of cases, this would not be required: in the event of damage to the copper, these articles would act as substitutes for it, and are pointed out with that view.

I have here, if I have succeeded in convincing parties of the sufficiency and practicability of the percolators, shown how a similar accident, or accidents, as the sinking of the "Spring," may be guarded against, and the vessel made very considerably stronger than before, at no very great expense, and as much water led to the pumps as under the old construction, or as they could discharge.

I consider it would be a great improvement while the vessel was in dock, to strip off the whole of her inside ceiling from the part just described, up to the covering board, and fill in all vacant spaces with strips of wood, driven against the outside planking, which need not be taken off, and then with Roman cement, as above recommended, or quick lime and fish oil, and lastly, with fillings on the inside to be well caulked, and which would most probably be water-tight, and then replace the ceiling as before, and caulk it, up to the covering board, without leaving any spaces for air.

As it is quite evident to any person on inspection of a vessel or boat lying on the ground, (the great danger in all cases to be provided against,) that the water does not remain at the kelson or pumps, but flows over to the bilge next the ground, and as it is the same thing with a vessel upon a wind at sea, where, if she heels much, the water does not come to the bottom of the main pumps, but lies in the lee bilge, as is well known to every seaman, I would propose to have bilge pumps, (unless found to be superfluous,) to be led down beside the main pumps in small vessels, and thence the pipes to be continued of lead along and inside the water-courses formerly described, forward, until they come abreast of the bilge of the vessel, where the greatest depth of the water would be, when the vessel was on the ground, or heeled over on a wind, and then to be led *over* or above the ceiling, striking off from the water-course at right angles, until it come upon the bilge at the said place, where the end of the pipe should be led down into a well, of say half the breadth of one of the bilge planks, or four inches, (not to weaken the bilge planks too much,) and say of ten, fifteen, or twenty feet long, made by cutting down one of the bilge planks from four inches to one inch thick, (in a new vessel laying a bilge plank of that length, breadth, and thickness,) and guarded at the sides and ends, from the entrance of coals, grain, seeds, ballast, &c. by percolators at the sides and ends, and a tight top to it, similar in all respects to the percolator formerly described at the main water-course, except that the guards and percolators might be of a little smaller dimensions, and a percolator and guard might be required at each side of the well, and the top would be hinged at the guard next the side, and fastened down to the other.

This well to have a float and marker also, led up over the ceiling and through the covering board, which would shew as far as the top of the well would allow it to rise, or about three inches, when there was any water in the bilges of the vessel. A percolator on one side of the well, would probably be sufficient.

These percolators and guards would strengthen the vessel very much at the floor-heads, which I consider, at present, about the weakest part of the vessel; and if about opposite to bilge pieces, on the outside of the vessel, would be like a small additional keel and kelson, on each side of her at the bilge, as shewn at Fig. 4.

A very great addition of strength to the vessel built on this construction would be derived from its not being requisite to have all the floor timbers of nearly the same lengths, as is the present practice, and consequently throwing all thefl oor-heads nearly in a line the fore and aft way.

I would thus have three inches under the adjoining ceiling, in the bilge, to drain the water dry off it. As there would now be no passage for the water from side to side under the kelson as formerly, except only at the foot of the main pumps, where the timber was cut down, the water from a leak on one side of the vessel might not find its way to the pumps on the other side, until it rose so high as to flow over the top of the kelson. The pump well to be caulked and made water-tight, from the ceiling to the deck, as a protection against the entry of sand, seeds, or any articles of a small grain, and to have a door at the bottom of it for access to the bottom of the pumps when necessary, and which door to be shut and caulked, when not in use, and the water to have a passage into the pump well only at the water-courses.

Bilge pumps as at present in use in merchant vessels, being led down or up between the outside bottom plank and the inside plank, or ceiling, appear to me to be very defective, and nearly useless; because, either the ceiling must be quite open above the ends of the pipes to let down the water, which is objectionable, as in effect weakening the vessel, and letting down sand, ballast, dirt, &c. between the timbers; or if the ceiling be caulked, and quite tight over them, which is in general the case, and water gets into the vessel, it comes up amidships at the limber boards, when the vessel is upright, and when she gets suddenly heeled over by being hauled upon a wind, or otherwise, it is then above the ceiling, and not a drop of it can get to the mouth of the pipe, and for which reason, we find vessels fitted with bilge pumps, damage their cargoes almost as frequently as those without them. It may also get in above where the ceiling is caulked, and cannot get down again.

Tacking, in a strong wind, with pumps fitted in this way, there may not be a drop of water at the bottom of the bilge pumps, while there is a considerable quantity in the vessel. Besides, the bilge pumps are frequently led straight up and down to the deck, between the timbers, and in small vessels in a heavy sea, the crew cannot stand forward, on either the weather or lee side, to work them. This would be my reason for leading them up beside the main pumps in small vessels and extending the pipe forward in the water-course. In large vessels, if bilge pumps should be required at all, they might be led straight up and down, from the deck to the bilge of the vessel.

The bottom of a vessel, fitted as I have just described, would resemble a field with four drains and wells, or pools, in it, viz. one on each side of the kelson, and one at each bilge, the bottom being, like the field, solid, and not hollow as at present.

These percolators, guards, &c. would naturally cause some alteration of construction, and I have thrown together my ideas on that subject.

ON A NEW METHOD OF CONSTRUCTING VESSELS, AND IMPROVING THOSE ALREADY BUILT.

It is not my intention to invade the province of ship builders, and to write an essay on ship building, or to give instructions in an art which I know but little about. The following principles, however, appear to practical ship builders, versant with the subject, as well as to myself, to be practicable, and would be an improvement, and I have attempted to describe them, however imperfectly I may have executed the object; and I must be understood throughout, as speaking of well seasoned wood, otherwise the vessel could not last.*

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* "However well an edifice may be planned, or the work executed, if the materials of which it is composed, do not possess these requisites, (strength and durability,) the architect's labour has been in vain, for its early destruction is inevitable."—*Knowles on preserving the Navy.*

"Timber may, in fact, have the seeds of dry rot within it, and yet by proper treatment be kept sound for a great length of time. Thus ships laden with particular cargoes, afford remarkable instances of the effects of such cargoes on their duration. The warm moisture created by a cargo of hemp is communicated to the timber, and promotes a rapid putrefaction. Mr. Chapman says that, the ship Brothers, built at Whitby, of green timber, proceeded to St. Petersburgh for a cargo of hemp. The next year it was found on examination that her timbers were rotten, and all the planking, except a thin external skin. A lading of cotton is always injurious to the ship, and even teak is affected by a cargo of pepper. The timber which

In building a vessel, lay the keel and rear the stem and stern posts in the usual way, observing, if strength is required instead of show, to give the vessel a round stern, on the principles and practice of Sir Robert Seppings.

Make a few floor timbers of ten feet and five feet lengths, so far as they will work, in the vessel, and tree-nail them slightly together into frames of two, making all the futtocks above the ends of them five feet lengths, which will give proper shifts till past the round of the bilges, when they may be made longer, observing, however, to make proper shifts. Put the centre of

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is brought from America, in the heated hold of a ship, is invariably covered over on being landed with a complete coating of fungus: it was the too general use of this timber in His Majesty's ships, that at one time increased the disease to such an alarming degree. Those ships on the contrary, which are employed constantly in the coal and lime trade are very durable, and have been known to last for a century. These effects are obviously to be ascribed to the exclusion of the air in the one case from, and the free admission of it in the other to, the interior surface of the ship, assisted in the latter instance by the absorption of moisture by the coals and lime, from the timbers and planking."—*Encyclopedia Britannica, Supplement, vol.* 3, *part* 2, January 1819. If the whole of vessels' ceilings were *thoroughly caulked,* would this heated air and moisture find admission between the timbers to produce the dry rot?—*Quære by J. B.*

"The real efficient cause, then, of the dry rot, is that of the juices of the timber being brought into a state of putrefaction, occasioned generally by exposure to a moderate degree of heat and moisture in a stagnant atmosphere."—*Supplement to Encyclopedia Britannica, vol.* 3.

each of these floors, over the middle of the keel, and put them up in their places, marking off certain breadths of the timbers to fill up exactly the vacant spaces left unoccupied, and run the ribands round them to get the proper form of the vessel. The length of the floors to be left to the discretion of the builder, as it is not intended to dictate, only to suggest.

Now beginning with the main frame floor of ten feet long, or five feet on each side of the centre of the keel, and, if working the after body of the vessel, make the next adjoining timber a five feet floor, or two and half feet on each side of the centre of the keel, and both of them without any taper or diminution of siding, (the fore and aft way,) and without any under water-course in, or under them, and before they are fastened together, make a third floor timber of ten feet long; the short floor timber of five feet, giving the proper bevel for it; and the middle of it to come over the centre of the keel also. Coat the sides of them which are to come in contact, well with vegetable tar, to exclude the air, the sides being properly squared and dressed to lie close together. Reduce the heads of the floors to the proper moulding, or thickness, the out and in way, and put five feet futtocks also properly reduced in moulding, on top of them, with square butts, and coaks, as before recommended, tarring the ends of the butts also. Continue this practice up to the gunwale, making proper shifts, and without any diminution of siding.

Now, tree-nail the long and short floor timbers together, with good Dantzic or Memel fir tree-nails, which will save the expense of metallic fastenings, and be sufficiently strong, as the timbers, when completed, will form one compact frame right round the vessel, and coat the tree-nails also over with tar, and draw a line with paint on the inside of the timbers, opposite to where they are driven, in order to keep clear of them when boring the auger holes the out and in way for the planking.* Proceed to fill in closely and compactly together in this way, until arrived at the next frame, which was put up aft, and which is now to be taken down and separated, and the foremost timber tree-nailed to the one immediately before it, and making the after timber a mould for the next adjoining one. There would thus always be a ten feet floor and a five feet floor alternately carried right across the middle of the keel, and tree-nailed to the one immediately before it, so far as the timber would work to these lengths, and a loose floor left for a mould to make the next adjoining one by. Make proper shift of the futtocks and top timbers, breaking the line of shifts as much as possible, and reduce the moulding, to guard against the vessel being crank, but not the siding, which will save both labour and expense, and allow the fillings between the timbers to be dispensed with nearly altogether. Proceed in this manner to the run and dead wood, where the floors might be either lengthened or shortened as required, observing to make proper shifts and butts, and thence to the stern-post, filling up the whole space with timbers of proper size, and using bolts where tree-nails cannot be used to advantage.

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* If boring holes for the tree-nails should be thought to wound the timbers too much, bolts may be used, the object of recommending tree-nails being solely to save expense in merchant vessels, and it is very obvious that very few tree-nails or bolts would be required, as the timbers, when close together, would support each other like the staves in an oval tub. I consider Dantzic or Memel fir tree-nails decidedly superior to oak.

Having thus formed the after body of the vessel into a compact frame, proceed in the same way with the fore body, making every timber to fay close on the one immediately abaft it, and coating them well over the sides which are to come in contact with tar, before tree-nailing them, or fastening them together, and the loose timber would always give the proper bevel for the one to come before it, until the whole space was filled up to the stem, and, if possible, no vacancies to be left for fillings or cement. As there would now be considerably more wood in the bottom of the vessel than under the present construction, where the first futtocks and filling in timbers are not carried across the keel, besides the wood about to be mentioned, it is probable the moulding or thickness of the timbers the out and in way, would not require to be reduced smaller than their dimensions under the present construction; but if decreased stability was apprehended, it would be proper to reduce the moulding, in proceeding upwards, and from the timbers being compactly joined together, and the decks being cross laid, and with stringers or shelf pieces above and beneath them, as about to be described, it is not apprehended there would be any diminution of strength, but a great accession of it, as compared with the present construction.

The vessel being now supposed in one frame, including the stem and stern posts, proceed and fill in any vacancies which may have been impracticable to fill up, either with mastic, quick lime, and fish oil, mixed together, resin and linseed oil, mixed together, vegetable tar and whiting mixed together, Roman cement and sand in the proportions recommended, or vegetable tar alone, both inside and out, and when all was so close that not a crevice could be observed (it would be just as practicable to fill up all interstices with one or other of the above substances as for a plasterer to fill up all interstices in a wall with plaster,) then fill in with fillings of oak as recommended. Proceed and horse and caulk the seams of the timbers inside and out, which will make the frame as tight as if it were cut out of one log of wood, or tree, like a canoe. Unless the vessel were built under a roof or shade, which is not to be expected, it would be necessary to have a few auger holes bored through some of the timbers at the bottom, to let out the rain water, while the vessel was building, which holes should be carefully plugged up, before the planking is put on. Figs. 7 and 8, Plate 4, shew a longitudinal section and a horizontal plane of the timbers united, and running across between the keel and kelson, as proposed to be done, the ceiling plank in both cases being kept out of view, to shew the placing of the timbers, and Figs. 9 and 10 shew the same views of a vessel, under the present construction.

The timbers being thus one solid and compact body along the keel, and firmly wedged together, would resist compression, and prevent hogging, or arching, and also sagging.

If building the vessel in single timbers, and joining them together, should be objected to, on account of not getting the bolts clinched, as in frames, it would be very easy to build the vessel in frames, and clinch the bolts, and put these frames close together, without leaving any vacant spaces to fill up with Roman cement, &c. as at present, and to mark with paint inside and outside the timbers where the bolts were driven, in order to keep clear of them when boring the tree-nail and bolt holes the in and out way.

After the frame was completed in this way, run feather-edged or wedge-like planks alongside the keel, the whole length of it, of four, six, eight, or ten inches deep at the keel, according to the size of the vessel, and of twelve, fifteen, eighteen, or twenty-four inches wide, or upwards, and run off to a check upon the timbers at the outside.* These will assist the keel in binding the timbers together—will protect it from damage by violence from without—will cause fewer bolts to be necessary through the kelson, timbers, and keel—will resist compression or extension, in proportion to the strength of their fibres, and prevent hogging or sagging—will assist the conversion of the floor timbers, and make smaller floor timbers serve—will assist in giving the inward curvature or hollow floor to the bottom, to prevent rolling at sea—will give another seam to caulk to guard against leaks, and, in short, will act nearly as two small additional keels, in strengthening and binding the vessel together, in the firmest manner, both transversely and longitudinally, and are easily fitted. They will also add their own weight in the bottom of the vessel, where it is wanted to increase her stability. With the addition of these, the keel might be nearly all housed, and although the part of it beneath the bottom plank should be entirely chafed off, the vessel would be quite safe. The vessel also to have a small false keel, in case of damage to the main keel, to preserve the fastenings. Figs. 4 and 5, Plate 3, present a view of these pieces.

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* Some builders are of opinion that it would be stronger to make the garboard strake and adjoining planks of additional thickness.

Before putting on the bottom planks, tar the outside of the timbers, to exclude the air as far as possible, and supposing them to be now on, and also the bilge planks of their proper thickness, fit bilge pieces on the outside of the bilges, of a proper thickness, similar to the pieces on boats called bearings, and carry them well forward and aft, and run them off to nothing at the ends. The upper and under part of these pieces to be supported by feather-edged planks, of proper size and thickness, like those described alongside the keel. Fig. 4, Plate 3, shews a view of these bilge pieces and supporters.

These pieces would be equal in effect when the vessel was afloat to two small keels, and enable the vessel to hold as good a wind, with a much shallower main keel than without them, and thus cause her to draw less water. They would also strengthen the vessel in the strongest possible manner at the bilges, by binding the whole timbers, bottom and ceiling planks more firmly together, and when the vessel was aground, prevent her taking so long a list, and consequently keep the strain in a great measure off the bilges and topsides, keep off the chafe from the bilge planks, and cause the vessel to rest on as many timbers as they extended to, instead of resting on two or three, as under the present construction, and as the floor heads would not now be so much on a straight horizontal line as formerly, these bilge pieces would not be objectionable, as receiving the pressure opposite to the weakest part of the vessel when aground.

When afloat they would make the vessel stiffer, by holding water like the keel, and also, from the additional weight of themselves in the bottom, where the weight is wanted, and make the vessel more weatherly, and counteract rolling, and resist hogging and sagging by compression or extension, in proportion to the whole strength of their fibres; in short, they would act as two small additional keels, always in their places, and at their duty at sea or on shore, and at the breaking up of the vessel, would bind the timbers together till the last.*

The same reasons, whatever they are, which make them desirable for boats, would make them desirable for larger vessels, and they would be easily fitted to their places. A vessel fitted with these pieces might have a shallower main keel than without them, and consequently draw less water.

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* I understood Sir Robert Seppings to say he approved of them.

Before working to the ceiling, cover the whole of the inside of the timbers with patent felt, which will exclude the air, and prevent the admission of water, without being very expensive, or adding much to the weight of the vessel. It would also unquestionably strengthen the vessel very much, to give her a few diagonal iron riders and braces, as recommended by Sir Robert Seppings, and which might be let down flush with the top or inside of the timbers, before the ceiling was put on, and thus take nothing from the stowage; or they might be put on above the ceiling, and flush with it, and thus bind it also, without taking any thing from the stowage.*

Supposing myself to be describing the lower deck of the 1200 ton East Indiaman, to which the drawings of Sir Robert Seppings refer, or any vessel of nearly similar tonnage, and which had a complete lower deck, middle deck, and upper deck, from end to end. Lay beams in the usual way, one before and one abaft all openings intended to be left for hatchways, &c. and about seven or eight feet distant from each other, on an average. Now run a stringer or shelf piece, of six inches thick and nine inches broad, (if the dimensions here mentioned, should not be found proper, they could be altered to proper dimensions, and the same construction preserved,) all round the vessel under the beams, and bolt these shelf pieces securely to the timbers, and fill up the spaces between the ends of the beams, to within two and a half inches of the top of them, and bolt these pieces securely to the sides.

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* "Experience, that touchstone of truth, has convinced me of this assertion. A vessel, called the Snipe, had her copper taken off the other day, under my inspection. She had, ten years before, been sheathed with wood, with the patent felt under, and had not made a drop of water during that period of time. When the copper was taken off, the sheathing appeared remarkably good; but being on ten long years, the owner thought it prudent to take it off, to examine the seams, being apprehensive the oakum might be rotten, but, to our astonishment, we found the bottom under the felt as dry as possible, the oakum as sound and good as ever, and positively it is a pity it was disturbed at all, and I am really of opinion it would have lasted ten years longer."—*Extract from a Letter from Mr. Edward Carey, Surveyor of Shipping, &c. at Bristol, to the Editor of the Register of Arts and Sciences, dated* 14*th May*, 1824. The above is a strong instance in point of the advantages of excluding both the air and water.

Before laying the beams, take a piece of good oak, of six inches deep and a foot broad, and lay it fore and aft, the thin way up and down, perpendicularly over the kelson, at the height of the beams, to support the middle of them and put a pillar or stantion under every beam to support the weight of it. These pieces and the stantions would require to be steadied in their places, in a temporary way, until the beams were got in their places. This piece to be scarphed where necessary, and to run from stem to stern of the ship, excepting the spaces to be left vacant for the hatchways, scuttles, or masts, and the ends of it to be supported by cleats on the stem and stern post. When the beams were got in, lay pieces of the same description, six inches deep under them, at the sides of all the hatchways, scuttles, pump well, &c. Now fill up all the vacant spaces between the middle of the beams, above these fore and afters, with pieces of wood of the same breadth to within two and half inches of the tops of the beams, whatever the rounding of them may be.

There would thus be supporters for a thwartship deck, or planks of two and half inches thick, at the middle of the vessel, and into the sides, and which should be filled up with good Dantzic or Memel fir deals of that thickness, all the way from end to end of the ship, until all vacancies between the beams, excepting the hatchways, &c. were completely filled up to a level with the top of them. As every plank would thus act as a beam, the ends of them where it might be necessary to join them, together should be hook scarphed, and a few coaks might be put into the sides, or edges of the planks, to hold them together transversely.

When all vacancies were filled up, it would form a complete thwartship deck, from end to end of the vessel, flush with the top of the beams, and partly filled up by them. It should now be slightly chinsed on the upper side, and then coated over with tar, or tar and linseed oil mixed together, to exclude the air. When it was well soaked with tar, lay fore and aft planking of two inches thick Dantzic or Memel fir above it, and the deck will then have its usual appearance from above.

Felt or tarred paper to be put between the under and upper planking to exclude the air, and the decks would seldom require caulking. If hair mixed with tar and pitch, such as is used by barge builders, and called setting in, were used on the seams of the thwartship deck, it would probably never again require to be done; or require to be caulked while the vessel lasted. As the under planking of the deck would always be dry, it may however be questionable, whether it would not shrink too much, for using setting in, instead of caulking, and it may be better to allow for shrinking.

Cross-nail the fore and aft planking well to the beams, and to the thwartship planking; and caulk the upper part of this deck, and the under part of the thwartship planks, unless setting in be used. Now bring an oak stringer, or shelf piece, of six inches thick and nine inches broad, right round the vessel, above this deck and bolted to every timber all round her, and which, with the stringers below it, will make two internal hoops right round her, to strengthen and bind her together, similar to the inside lining, and chime hoops of a sugar hogshead. This stringer to be fitted close down on the top of the fore and aft planking of the deck, and the upper and under stringers with the thwartship planking, filling-up pieces, and fore and aft planking and beams, to be all well and securely bolted together, with a bolt to go through each thwartship plank.* Discretion to be used, not to drive too many bolts into the stringers to run the risk of splitting them, or weakening them too much; and the stringers, if considered requisite, to be made of larger dimensions. An iron standard to be carried up from the end of every beam, and bolted to it, the side, and beam above it.†

There would thus be a complete fore and aft and thwartship deck of four and a half inches thick, binding the vessel together, both longitudinally and transversely, in the strongest manner, and acting both as a wedge and a tie to prevent hogging, or sagging; and, in fact, appearing like a continuation of the bottom and sides extended over the decks, and, as it were, forming a part of the body of the vessel, and all the up and down, and fore and aft wooden knees dispensed with, and their purposes better supplied by straight and more easily procured wood.*

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* It would be an easy matter in East India ships, to have a few chests of tea with the corners taken off them, to fit the space required by these stringers,—and which could not prejudice the sale of the teas,—and would lose very little stowage.

† Sir Robert Seppings was of opinion this was superfluous, and that the expense might be saved.

The whole carlings and ledges might also be dispensed with in small vessels. These perpendicular and fore and aft wooden knees, and carlings and ledges, and additional beams, also break the stowage very much, and occupy more space than a shelf piece or pieces, and a solid four and half inch deck would do. There is also very considerable labour and expense in fitting and fastening them, and in warm climates, owing to the shrinking of the wood, the carlings and ledges frequently become too short, and loose. In large vessels it would be proper to have carlings, half way between the midship fore and afters, and the sides, or more of them to support the thwartship planks.

Now, supposing the hold to be filled with cargo, lay on the hatches cross-laid also, and secure them down with a fore and after *above* them, as well as *under* them and hatch bars; and fit hatches of the same kind, and secure them in the same way in the pump well, and fit wedges to act as stop cleats nailed upon the masts: caulk all so securely that not a crevice shall be left any where, on a level of the deck for water, either to get up or down at.

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* A general distribution of strength has also been attended to, for no axiom is more true than that "partial strength in any machine is general weakness."—*Knowles on preserving the Navy.*

Now proceed in the same manner with the 'tween decks and upper deck, making them lighter and thinner, and paying particular attention to keeping the upright stantions in their places above those below, to support both from *above* and *below*.

It is now evident that, as there would be no vacancies nor interstices for the water to get up at, above this lower deck, between the timbers at the sides of the vessel, as is the case under the present construction, and is so in ships of war even to this day,—This lower deck, in addition to giving more stowage, by dispensing with the clumsy wooden knees, and many of the beams at present in use, carlings and ledges, at the expense of a 4½ inch deck fore and aft, would have completely the effect of a double bottom to the vessel, to prevent the water rising higher than the level of this lower deck, (this is the reason for carrying the fore and afters under the beams,) so that supposing the vessel to get on rocks and knock her bottom out altogether, bottom planking, timbers, and ceiling, so long as she did not shiver her timbers to atoms, and thereby let water up at the sides, she would be comparatively safe to what any vessel built under the present construction would be, in a similar predicament.*

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* Capt. Inglefield in describing the loss of H. M. S. Centaur, says, "That the water forsook the hold and appeared between decks, so as to fill the men's hammocks to leeward: the ship lay motionless

When the weather moderated, if she held together so long, (and she would be enabled to do so much better than any vessel built on the present construction,) by taking out the cargo, throwing it overboard if indispensably necessary to keep her from upsetting, and to save the vessel and the remainder, and using proper measures to heave her off the rocks, which this very process of lightening would assist in doing, and at the same time divesting the vessel of all unnecessary top hamper, she might be taken in safety to the East Indies and back, on this same lower deck as a bottom, plugging up the pumps beneath the lower deck, to preclude the admission of water, and opening a scuttle like a sluice in dock gates, shortly above

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and to all appearance irrecoverably overset. The water increasing fast, forced through the cells of the ports, and scuttled in the ports from the pressure of the ship. I gave immediate directions to cut away the main and mizen masts, hoping, when the ship righted, to wear her. The main mast went first, upon cutting one or two of the lanyards, without the smallest effect on the ship; the mizen mast followed upon cutting the lanyard of one shroud, and I had the disappointment to see the fore mast and bowsprit follow. The ship, upon this, immediately righted, but with great violence; and the motion was so quick that it was difficult for the people to work the pumps." Now, had the Centaur's timbers been filled up solid, or united together, above the lower deck, the water would not have got up at the sides to appear between decks and fill the men's hammocks to leeward, and as this would have powerfully counteracted the ship's upsetting, the probability is, that the ship and crew might have been saved, instead of the dismal catastrophe which followed. May not a similar catastrophe happen to any vessel which is not filled up solid above the lower deck?

it, to take out any water which got into the vessel through the lower deck or otherwise.

All this might be done with a fore and aft deck, as at present laid, but not without the timbers being close together, or filling in between them at the sides of the vessel, to prevent the water rising there, which shews another good effect of making the frame a solid compact mass from keel to gunwale.

Would not this be a great advantage, to have a separate and detached double bottom to vessels, always in its place and ready for use, and taking nothing from the stowage?

This practice extended over all the decks, and particularly the upper one, is also a double security, instead of a single one, against a leak from aloft. If the proportions were thought too heavy for the upper decks, they might be reduced to three inches of thickness, or less, and still the same method preserved.

The decks of small vessels, either to be laid on this construction or not, as approved of, the intention being to shew how it would strengthen the vessel, protect her against leaks at that part, and act as a separate and detached bottom. Such a deck or platform would be very desirable in steamers, to be placed under the boilers (and it is easy to fit one,) and with water-tight cabin and forecastle decks, and bulkheads, the passengers would have little to fear, either from the bursting of the boilers, or from the vessel getting ashore, unless the weather and circumstances were such as would knock a vessel to pieces, although made of iron or steel. Suppose the vessel to be bilged, and the hold full of water, if she could be got off the strand or rocks, the cabin and forecastle being air tight boxes, would keep her afloat. Admitting her to separate in the middle, the cabin and forecastle might afford both shelter and safety to the passengers and crew, till relief could be got. At all events they would be infinitely safer than under the present construction, with only the outside planking for a defence against the sea, and no defence whatever against the steam and hot water, in the event of the boilers bursting.

In the circumstances above mentioned of striking on rocks, a ship of war, after she had thrown her guns, &c. overboard, to lighten her and preserve her stability, and had got off the rocks again, would be perfectly safe, though she had knocked the whole of her bottom out.

At present, when a vessel of war gets bilged on rocks, no use is made of the empty water tanks, and casks, and empty spirit casks *inboard*, for the purpose of floating the vessel off the rocks.* Now, each of these articles, if closed or bunged up, is an air-tight buoy, and will support a very considerable weight in the water, in proportion to its bulk. The reason they are not made use of for this purpose is obvious. The weather is probably too tempestuous to admit of their being made use of outside of the vessel, and the timbers not being close at the level of the lowest deck, there is no double bottom to the vessel. But these articles are equally available for the purpose of floating the vessel off the rocks, inside as outside, and supposing her to be in a tide-way, where the water rises and falls several feet, and to be bilged, by securing as many of these as would cover the surface of the water at low water, as low down as could be got, and blocking them up, to prevent their rising with the rise of the tide, by all spare spars, wood and buoyant articles of every description on board, under the orlop or lower deck, and then caulking the hatches above them, they must act as a powerful means to float the vessel off the rocks, and the lowest deck being now water tight, would act as a double bottom, instead of allowing the water to come up between the timbers, as it would do under the present construction, and the vessel to founder. There would, in all probability, be enough of the ballast and bottom of the vessel remaining to add to her stability, and to prevent upsetting. The pump well to be caulked, and the pumps to be shortened, or a sluice opened above the lower deck, with hand-pumps to take out the water off the lower deck. With the chain pumps in the well, the water would rise no higher than its level outside the vessel. While the vessel was on the rocks, and doing all this, there would be no fear of her going lower down. The same practice would apply to merchant vessels in the same circumstances. If there were any spare empty water or spirit casks on board, and the weather should be sufficiently moderate to permit it, lash them outside of the bottom at low water, to strong cleats bolted or nailed down as low as could be got, and to which, studding sail booms or other small spars might be lashed, if it was impracticable to get ropes or chains under the vessel's bottom; and these casks, after the vessel was floated off the rocks, could all be cut adrift. There would thus be means used inside and outside the vessel, to get her off, and when she was off there would be no danger of her sinking.

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* See M'Leod's Wreck of the Alceste.

Lead pipes as scuppers to be led from every deck, which did not have scuppers leading outside the vessel down inside of the ceiling, and when the vessel was not aground or in danger on rocks, the mouths of these scuppers to be always open to convey any water into the water-courses, but if the vessel was ashore, as water would flow up them as well as down them, before heaving off the rocks, plug them up or flatten the pipes. If the lower deck was filled with cargo, and not accessible, plugs might be continued up to the upper deck, to be driven in when occasion required.

The principal objections to the above mode of construction and caulking the ceilings, except the expense, has been the want of a method to convey any leakage at the sides, down to the bottom of the vessel, without its coming in contact with the cargo; and of a reservoir or pool, to hold water in, if it did get into the vessel, to keep it from lying immediately amongst the cargo in merchant vessels, similar to the reservoir or pool, which is at present formed between the timbers, the outside bottom plank, and inside ceiling plank. Let us see therefore if these objections cannot be obviated and overcome.

It is fixed by law, that all vessels carrying dry cargoes, must dunnage six inches on the flat of the floor, and nine inches in the bilges, and proportionally upwards.* This dunnage is usually composed of iron ballast, stones, or wood, being solid substances which fill up their own spaces, and they are in general laid, not only under the ends of packages, but also under the middle of them. Now when water gets above the ceiling in vessels, this dunnage, if laid fore and aft, stops it from flowing athwartships, and if laid athwartships, stops the water from flowing fore and aft, and with the pitching and rolling of the vessel, conducts the water up to and amongst the packages, instead of protecting them. It is therefore of little or no use in protecting the cargo, when once the water gets above the ceiling; but if omitted to be placed the specified height, and the vessel damages her cargo, the ship owner is assuredly subjected in damages, as is well known to many individuals by experience, whether the dunnage would have been useful or not.*

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* *Dunnage.*—The quantity of dunnage in a ship, having a perishable cargo, should not be less than six inches deep in the flat of the ship, and nine inches on the bilge. The ship-owner is liable for any damage sustained by the goods, when that quantity of dunnage is not allowed; it is indeed frequently insufficient. The master, therefore, should attend particularly to a loading of this description, observing to stow all casks bilge free, and all liquids below dry goods.—*Steel's Ship-Master's Assistant,* 18*th Edition.*

Nothing can be more self evident than, that vessels carrying different cargoes, would require to be prepared and fitted with dunnage in different degrees, and I will take an instance of both a heavy and a perishable cargo, in supposing a West Indiaman loaded entirely with sugars, and built as solid as a bomb-proof wall to the inside of the ceiling, and consequently having no pool or space to hold water in, except the water courses and the pump well.

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* "It is, therefore, the duty of the master to provide ropes, &c. proper for the reception of the goods into the ship. She must also be furnished with proper dunnage, or pieces of wood, placed against the sides or bottom of the hold, to preserve the cargo from the effects of leakage, according to its nature and quality."—*Holt's Shipping and Navigation Laws, 2nd Edition.*

Now to fit her for preserving her cargo, begin at the upper deck, and nail dunnage battens of an inch thick and two inches wide, and about eighteen inches distant from each other, the up and down way, upon the sides of the vessel all the way from stem to stern, until stopped by the 'tween decks. Immediately under the 'tween decks, proceed in the same manner, and so on through any number of decks; and in the hold, making the dunnage battens there about two inches thick, the out and in way, until arrived near the bilges of the vessel, where they should thicken more still, and at the bilges should be six inches thick, and from this they may decrease a little in thickness to four and a half inches on the flat of the floor and at the kelson.

Bore scupper holes through the 'tween decks at the sides (not through the vessel's sides), and all the decks under it (if any) between these battens, at such distances as may be thought sufficient to conduct any water down, and put lead pipes into them, flattening them if necessary, to lie between the dunnage boards and the ceiling, which are to be continued down inside of the vessel all the way to the water-courses at the kelson, as before mentioned. Now, beginning close up, under the upper deck, nail boards of an inch thick or upwards on these battens, and keep the upper edge of the next board an inch or two above, and outside of the lower edge of the uppermost board, which will cause them to lie shingle-board fashion, or like a clinker-built vessel's bottom, and will obviate the necessity of any caulking of them being required. Proceed in this manner till stopt by the 'tween decks.

Then proceed again in the same manner under the 'tween decks in the hold, until below the bilges in the vessel, when the planks may be fitted edge to edge, without overlapping, and made two inches thick, and if thought desirable, may be bolted to their places, and caulked, and limber-boards fitted above them, exactly similar to the limber-boards fitted under the present construction above the timbers. This will make the dunnage on the flat of the floor six and a half inches thick, being half an inch more than the law prescribes, but something is wanting to make up the prescribed quantity at the bilges, as an equivalent. Supposing it did take half an inch from the stowage, of what value is it, when compared with the advantages of it? Abundance of hollows, or notches, for under water-courses, to be cut out of these battens on the lower part, to allow the water to flow freely fore and aft, and in every direction past them, and the water-courses to be sunk under the level of the ceiling, and the lower ends of the dunnage battens to be supported by a piece of wood, nailed on the kelson.

It is now evident that any water which got into the vessel at the gunwale or sides,—*one additional security at the decks, and two at the sides against leaks, being always, however, kept in view,*—would be conducted between the ceiling and these boards down the sides of the vessel, until it was collected in the bottom of her, without ever coming in contact with the cargo at all, and it is matter of calculation and demonstration that there would be a greater vacant space to hold the water in by this method, without taking any thing, except what the law prescribes from the stowage of the vessel, than under the present construction, where there must be at all times six or eight inches of water in the vessel, which cannot be taken out of her, because it is not possible to carry the bottoms of the pumps under the level of it, and supposing the timbers to be twelve inches deep, there is a space of only five or six inches more between the timbers and at the ends of the futtocks for the water to gather in, till it is above the ceiling, besides the risk of the under or upper water courses being choked, and the dunnage being a solid body, gives no protection to the cargo, as before mentioned. Water taken in amidships would find its way down at the limber boards, as under the present construction.

This method, therefore, by having a vacancy of four and a half and six inches all over the floor and bilges of the vessel, and in the water-courses under the dunnage planks, gives more space for the water to collect in, with the additional advantage of putting it in the power of the crew to take it all out excepting a few buckets full in the well, by having the bottom of the pumps carried below the level of it, and would always secure the ship owner from the responsibility of the ship not being properly dunnaged to stand survey, which may have been attributable to the neglect of the master or mate, but from whom redress can seldom be obtained.

I am aware that it may be said there is, under the present construction, the reservoir below, and dunnage above the ceiling, but I consider it clearly matter of proof, that there would be more vacant space to hold water in by this proposed construction than there is by the present, besides *two good securities more against there being any water to hold*, and the vessel strengthened, consolidated, and fortified against leaks in every direction. Wood for beds, quoins, chocks, &c. would also be required for stowing cargoes, which would form additional dunnage, besides the vacancies formed between the ballast (if any) as at present. Casks containing liquids must be stowed bilge free, that they may not be injured by their own weight, and the weight above them. This would give additional space to hold water in, if there were perishable goods immediately above or around them. This construction would do away altogether with the necessity of having percolators, and excepting with perishable cargoes, these dunnage battens and dunnage boards would not be required, and need not be fitted. They might be made exactly to represent a vessel's present ceiling. The vessel might also be fitted with percolators if approved of.

The lead scuppers for conveying the water or leakage out of the 'tween decks or lower decks, into the water courses, would preserve the vessel's side, by keeping it dry, better than the present construction, where it is conveyed down between the timbers, and where the air cannot get free access to dry them again, and consequently causes them to rot.

These dunnage battens and boards, besides protecting the ship owner from claims of damages, for the vessel not being properly dunnaged, would also of themselves strengthen the vessel very much, and fasten the ceiling to the timbers, and it cannot be too often repeated, without taking more from the stowage than is enacted by law. I am aware that it may be objected against them, that the weight of the sugar hogsheads, and the use of the screws, crowbars, samson posts, &c. necessary in stowing the cargo would knock the dunnage boards to pieces; but it will be observed I have taken one of the heaviest cargoes I know of, which vessels carry, to provide against, and that the remedy in this case would be, to place the dunnage battens closer together, and use mouth pieces, and that no form of construction will provide against recklessness and carelessness, or will meet all objections which may be made.

An objection has been started against a West Indiaman *being too tight under this construction*, and washing her lower tier of sugars by the drainage from the upper tiers lying amongst it, as the molasses, when unmixed with water, would be of too glutinous a nature to be pumped out. It is at all times easy to let water into a vessel, and a very simple method of doing it in a merchant vessel, is by having a branch pipe from the head pump, such as is customary in the Leith and other smacks, called a sweetening pipe, by which water could at all times be pumped into the vessel, until she sunk.* When the pipe is not to be used, put a plug into it, as is done in practice. The index at the main pumps would always shew on deck when there was water enough in the vessel, and it was approaching the ground tier of sugars. Where a supply of fresh water was at hand, it would be better to use fresh than salt water, to liquidate the molasses, and thus preserve the molasses useful for many purposes.

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* In ships of war, water is let into them by turning a cock, but this would not be so easily practicable in merchant vessels.

On fixing on the plan of the vessel, it would be necessary to determine whether she was to be fitted with percolators or not. If she was to be fitted with percolators, I would recommend a plank to be laid under the kelson of an inch and a half thick, the whole length of the vessel, and nearly the breadth of the kelson; and the adjoining planks on both sides of which would form the bottom of the water-courses, to be of the same thickness; and the inner seams of them, which it will be observed, would be covered with the kelson, to be well caulked before it was laid. These seams being covered with the keel, timbers, and kelson, would, I apprehend, never require to be again caulked, unless the kelson was required to be lifted; and the outer edges of them would be thrown out, where they would be easily accessible for caulking.

Before laying them and the ceiling, tar the timbers as on the outside, and lay patent felt between the inside of the timbers and ceiling, as before mentioned.* Make all the ceiling plank from these water-courses to the bilges three inches thick, and four inches at the bilges. In very large vessels make the inside bilge planks five inches thick. With a three and four-inch ceiling there will be a fall into the water-courses at the kelson of an inch and a half, and at the bilges of three inches, as formerly mentioned.

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* " A felt composed of hair, manufactured by a Mr. Wood, has been used for the protection of ships' bottoms, from worms, by being

If the vessel is not to be fitted with percolators, make the ceiling of the same thickness as usual, and it will be observed, from the additional weight of the percolators themselves, if fitted with them, and the thicker dunnage battens, and dunnage planks in the bottom of the vessel, and the weight of the outside bilge pieces, that besides strengthening the vessel, they will add a great deal more weight in the bottom of the vessel than under the present construction, and consequently add to both the safety and stability of the vessel.

In working to the outside planking, lines should be drawn on the inside of the timbers with a different coloured paint from the lines shewing the treenails, to point out the breadth and seams of

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placed under the sheathing, with success. This was put upon the Isabella and Dorothea, ships employed on the voyage of discovery to the Arctic regions, and probably prevented their foundering when crushed with ice."—*Knowles on preserving the Navy,* page 137. Although a vessel's bottom or sides were bruised in, so long as they were not separated, the felt would oppose the entrance of the water, and might thus preserve the lives on board at least, and which by the admission of water might otherwise be lost.

the planks outside, which may be easily ascertained by measurement from treenail or bolt-holes, bored from the outside, and which would enable the treenail holes to be bored from the inside of the timbers at the proper places, without coming too near the edges of the outside planks to split them. Although some of these treenail holes should not be observed on the outside to be bored back again through the ceiling, water would not get into the vessel, with a tight ceiling and patent felt, as it does at present, as is but too well known in practice; and the neglect of filling the treenail holes, which, under the present construction, has been the cause of the loss of many a vessel, though no less reprehensible, would be less dangerous.

It only remains under the head of construction to point out how all vessels already built may be improved, and rendered safer, at a cheap rate; for it must be particularly observed, that there are two methods of doing it—the one by filling up all solid between the timbers; the other method, though less complete, by simply caulking the ceiling, in a less expensive manner than pointed out for the "Spring."

ON IMPROVING THE CONSTRUCTION OF VESSELS ALREADY BUILT.

Either caulk the limber boards as they at present are, making them a little thinner, to lie flat on top of the timbers, and give a fall for the water from the adjoining ceiling, or take a thinner plank instead of them; or, as water would flow across from side to side, between the outside and inside planking, if this method only was adopted, and which, if it was in large quantities, would be objectionable—to prevent which lift all the limber boards fore and aft, and the two adjoining ceiling planks, and fit chocks the breadth of the kelson, and to fill up the depth between it and the keel, and put them in their places opposite to the end of the first futtocks, and filling-in timbers. It is of no consequence whether they fill the whole vacancy or not.

Then fill up all vacancies from end to end of the vessel, under where the planks are lifted, with blocks of sound wood, leaving water-courses under them, Roman cement, or mastic, or quicklime and fish-oil, and fillings on the inside, to the height of the inside of the timbers, and caulk all securely, leaving water-courses inside of the timbers, by leaving a passage for the water at the back of the ceiling, and between it and the inside of the timbers, opposite to the bilges, if intended to have bilge-pumps. In either case put a cistern, lined with lead, under the bottom of the pumps, deep enough to allow the water to flow from side to side under the kelson, inside of the vessel; for which purpose the pumps would probably require to be shortened. It would be better to let the main pumps remain as they are at present, with their bottoms carried under the ceiling to take the water off the outside bottom plank, and make the ceiling and limber boards completely water-tight above them. Then put down another pair of pumps—which might be done in the same pump-well—with a cistern under them, to take all the water off the ceiling or inside planking. The bottom of the main pumps, which are carried below the ceiling, to be fitted with plugs, to be put in, or taken out occasionally.

Supposing, a vessel to have been on the rocks, and to have knocked off a dozen of her outside bottom planks, which under the present construction, would have caused the inevitable loss of her: in this case it would be of no use to work the pumps which were carried below the ceiling, as it would only be pumping water into the sea and out of it again. But supposing the vessel to be floating on her ceiling plank, and that there is five feet water in the hold inside of it; then, drive the plugs into the pumps, which are carried below the level of the ceiling, so low down that the top of them shall not be higher, or much higher, than the level of the ceiling, and which will effectually stop the water from getting up at the bottom of the pumps. Now draw up a sluice at the side of these pumps, with which they are to be fitted, exactly and precisely similar to a sluice in dock-gates, to admit the water into them above the plugs, and the level of the ceiling, and there is at once a pair of pumps in their place to pump out the water from above the ceiling. All this may be done without ever going off the upper deck, and even although there should be ten or fifteen feet water in the hold above the ceiling. When the vessel gets into dry dock draw up the plugs, shut down the sluices, and every thing will again be in *statu quo*.

The additional pair of pumps which had their bottoms above the cistern would require no alteration, and there would thus be two pair of pumps, instead of one, to take the water out from above the ceiling, and preserve the vessel and lives on board. All this might be done with steamers, as well as other vesssels, and without lifting the kelson. Caulk the ceiling from the kelson to the covering-board. This would strengthen the vessel very much, and counteract hogging or sagging.

It will be no good argument against caulking a vessel's ceiling, to say that it is too open to caulk, or will not bear caulking from decay, because this is only admitting that the ceiling is defective, and it ought to be made closer or repaired. Unless the ceiling was well and securely fastened to the timbers, there might be risk, that if a large portion of the outside planking was off, the weight of the vessel swimming in the water might force off the ceiling plank, and it would therefore be necessary to have the heads of the tree-nails, which should pass through outside planking, timbers, and ceiling, well plugged and caulked on the inside, and some additional dump bolts or spikes driven into it, and the dunnage battens, when put on, as formerly mentioned, should be on timbers (not between them) and well fastened to the timbers. The ceiling plank against the dunnage battens would then resemble the outside plank as at present against the timbers, and it would also be supported by the weight of the ballast or cargo.

A cheap method of repairing the ceiling may be adopted, by bringing a doubling of good fir plank over the present ceiling, and bolting and nailing it to it and the timbers, without disturbing any of the fastenings of the present ceiling, and caulking this doubling.* I am sensible that there are parts of a vessel's ceiling, particularly about the runs, and forward, which it would not be practicable to get at to caulk; but in this case use a little mastic mixed with oil, or the other substances recommended, in such parts, which will preserve the wood, keep soft and pliable, notwithstanding the working or straining of the vessel, and prevent the admission of water from the outside. Quick-lime and fish oil, mixed together, might also be used advantageously for this purpose; and either of them would answer the purpose better than Roman cement, on account of their greater flexibility and pliancy. Either by caulking, or the use of these substances, the whole ceiling might be made perfectly water-tight; and even in the case of doubling the ceiling, but little space would be taken from the stowage. This doubling the ceiling would also very much strengthen the vessel.

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* "The practice of placing doubling on ships not only gives them an increase of stability, but also strength in a part where it is much required, viz. at, and a little above and below, the line of water. With the latter view, Mr. Snodgrass, who for many years filled the office of Surveyor of Shipping to the East India Company, gave as his opinion, in the year 1792, before the Commissioners of Land Revenue, that no ship should have a thorough repair, but instead of this, that their bottoms and upper works should be doubled with three inch oak plank, from keel to gunwale, and strengthened with knees, standards, and even with iron riders, if necessary, all which may be done at a small expense, and ships so repaired would be stronger and safer, and be able to keep the seas longer in the worst weather than

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any new ships in His Majesty's Navy."—*Knowles on Preserving the Navy.*

It will be observed that this doubling recommended by Mr. Snodgrass has just the effect of making the vessels solid from keel to gunwale, so far as the thickness of the plank recommended goes, in addition to the former outside planking, and it appears to me there cannot be a question of the advantages of it, and being put on the outside of vessels, it would strengthen them, add to their stability, take nothing from the stowage, and preclude the admission of water, in the first instance (the great point to be attended to,) and, consequently, would be far preferable to doubling a vessel's ceiling.

I am quite of Mr. Snodgrass' opinion, that a vessel, when doubled, is stronger and safer than when new without doubling.

Supposing the vacancy between the outside and inside planking to be full of water, either salt or fresh, it would completely prevent the dry rot, or stop it if already in progress.* As to the want of air causing the timbers to decay, we do not find the inside of a nun buoy, or a buoy moored on a shoal, or water casks, &c. all of which are nearly similar, and none of which are perfect vacuums, and are even sometimes not perfectly tight, to decay so fast as the outsides of them. The lining or panneling of vessels' cabins over the ceilings prevents the accession of fresh air between the timbers opposite to it, and we do not find by experience that the timbers decay so fast opposite to it, and where the air is so excluded, as they do in other parts of the vessel, and we find this corroborated by the experience and opinion of ship breakers.

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* "The mast of the Kangaroo sloop of war was dug out of the mud at the bottom of the mast pond, at Deptford Dockyard, where it had been fifty years, and was one of the most serviceable masts in the navy."

"The Resistance frigate went down in Malta Harbour; but as she had been reported in such a state of dry-rot, or rather the surface of her timbers so covered with fungus, as to render it expedient to send her home, she was suffered to continue under water for many months. On her arrival in England it was observed, that all appearance of fungus had vanished, and she remains a sound ship to this day. Yet even this fact did not seem to have attracted much attention. But when the dockyard was removed from the northern to the southern side of Milford Haven, a few loads of timber that was covered with fungus were suffered to remain in the water for several months; and it was observed, that after being taken out and stacked in the new yard, the timber did not exhibit those appearances of dry-rot, which the same timber did most abundantly, which had not been immersed in the salt water. This fact being reported to the Navy Board, it was proposed to sink one of two sister ships, the Mersey and the Eden, both alike infected with the dry-rot, in Plymouth Sound. The Eden was the ship selected for this purpose. She remained under water for about eighteen months, and on being raised, every trace of fungus had totally disappeared, while the Mersey was almost covered with it. After remaining a year at home, perfectly sound, she was sent out to the East Indies, where she now is."—*Supplement to the Encyclopedia Britannica, 4th and 5th Editions, January,* 1819.

The principle I am assuming throughout the fabric is, to exclude the air entirely, since I cannot admit it freely, and where I cannot exclude it, close it up, as if it were hermetically sealed. Allow no accessions of fresh air, and it will do no harm.

The following are quotations from various sources in favour of the total exclusion of air, or, at least, so far as it is practicable:

" Neither is there the least proof of the old *Royal William*, recently broken up, when a century old, being built of winter-felled timber. The fact is, that she was rebuilt half a dozen times, and the only old and original timber remaining in her was in the lowest part of her hull, always immersed in the salt water externally, and washed with the bilge water internally, and the wood from this part of her, when broken up, was perfectly sound, but quite black, having the appearance of being charred."—*Supplement to the Encyclopedia Britannica, vol.* 3, *page* 681. *Article, Dry Rot.**

As these timbers would always be covered up with limber boards, and iron, and shingle ballast, they could get no accessions of fresh air, which would increase their durability, and as they would be occasionally wet and dry, the fair inference is, that the exclusion of air tended to preserve them.

" The sound condition in which these floors and first futtocks that lie horizontally in ships are usually found, has led to the conclusion that this is produced by the damp state in which they are continually kept; but there is reason to believe that their being protected from the influence of the air, by being covered with the iron or shingle ballast contributes also to this effect."—*Knowles on Preserving the Navy, page* 135.

What can it be owing to, that a vessel's bottom, if kept from damage, will wear out three sets of topsides? Can this be owing entirely to the greater fatigue or labour which the topsides have to undergo, and to the bottom being in general always in one element, or has not the action of the air to which they are much more exposed than the bottom, a considerable effect in producing the decay of the topsides? If the advocates for air will insist on the admission of it, take off a ceiling plank immediately above the line of load water floatation (the water will not rise above its level on the outside of the vessel, although the space be filled with it, between the inside and outside planking) and take off every alternate ceiling plank, from this up to the gunwale, which will admit much more air than under the present construction, but it must be observed it will weaken the vessel.

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* The term dry-rot should be for ever expunged from the English language, and the disease called by its proper name, viz. sap-rot, proceeding from unseasoned wood.

" The contact of water and air are the chief causes of the decay of wood, therefore, if any means can be devised to prevent the access of air and moisture, the wood may be secured from decay. This principle may be illustrated by supposing a cylinder of dry wood to be placed in a glass, or case, which it exactly fills, and the two ends of which are, as it is called, hermetically sealed, or entirely closed. Who will doubt that such a piece of wood might remain, so enclosed, in the open air, for a thousand years unchanged." —*From the Register of Arts and Sciences*, 1824, *vol.* 1, *page* 127.

Caulking, if the vessel did not throw the oakum out of the seams by straining or labouring, would be hermetically sealing, and air would sooner penetrate through the pores of the wood than at the seams.

The following is also a quotation from the same article in the Register of Arts and Sciences :

" The composition which experience has proved to be the best adapted for the preservation of wood from both species of decay (viz. the wet and dry rot,) is as follows :—melt twelve ounces of rosin in an iron pot or kettle; when melted add twelve ounces of roll brimstone, and just when both are in a liquid state, pour in three gallons of train or whale oil. Heat the whole slowly, gradually adding four ounces of bees' wax, cut into small bits : frequently stir the mixture, and as soon as the solid ingredients are dissolved, add as much Spanish brown, or red or yellow ochre, or any other colour, first ground fine with some of the oil, as will give the whole a deep shade. It will now be fit for use. Lay on this paint or varnish as hot and thin as possible, and some days after the first coat becomes dry, give it a second. These coats will preserve planks, &c. for ages. What remains unused will become solid on cooling, and may be re-melted for future occasions."

If it be an object to preserve vessels from decay, would it not be advisable to give the ceiling and whole inside of the vessel a coat with this mixture. There is nothing unintelligible in preparing the mixture, nor are the ingredients very costly, and seamen are in the practice of preparing similar ones, for paying the seams, coating the bends, bottom, &c.

A bilge pump to be fitted to take any water out which might get between the outside and inside planking, although if the ceiling were perfectly tight, this water would not get into the vessel, and the only effect of this would be to prevent the water rising to where it might come to a leak in the ceiling. In this way, a vessel would be very similar to two vessels under the present construction, inside of each other, with a set of planking and a set of pumps inside of each, the outside planking, main and bilge pumps, being one set, the inside planking water-tight, and main pumps, with cistern, another. In point of effect, against leaks, it would just be one vessel inside of another.

I have throughout taken no notice of the wood and copper sheathing to vessels' bottoms, as all of these are intended to be the same as at present, and I may only remark, that as the whole fabric would be much stiffened and strengthened, there would be much less strain on the sheathing.

A vessel on the solid construction would also be much easier repaired, as in the event of a few floors being broken, they might be replaced without having to lift the kelson and ceiling on both sides as at present.

Plate 5, Fig. 11, shews part of the longitudinal section of a merchant vessel, cut off at a line perpendicular to the outside of the keel, and shewing only an inch and a half thickness of plank, from the water and inside of the vessel, and Fig. 12 shews a section of a vessel, as above described, having very little additional materials in her, and with eighteen and a half inches of thickness of wood, from the water to the inside of the vessel.

Having given an instance of a vessel sinking by grounding on her anchor, let us now give an instance of a vessel sinking from the common occurrence of springing a leak at sea, and which it may be observed is also an occurrence happening daily in some part or other of the world.

The following is copied from the Scotsman Newspaper of 14th May, 1831:—

"The sloop Mind, of this port (Dundee), James Watson, master, has been lost while on her passage from Balahulish with a cargo of slates. On Thursday last she was overtaken with a severe gale from the north, accompanied with a heavy shower of snow, when about twenty miles off Kinnaird's Head, and sprung a leak. The crew abandoned her next morning at eight o'clock, and were picked up by the Clyde, of Glasgow, bound to London. They were afterwards transferred to another vessel, and have now arrived here. They saved nothing."

Here then is an instance of a vessel sinking, and the crew losing their property, and running the risk of losing their lives, from the common occurrence of springing a leak at sea. This might proceed from starting an outside butt, or plank end, with a laboursome cargo, or from other causes. Now, had this vessel's ceiling been thoroughly caulked, although the water had passed the outside planking, it would not have got into the vessel, and she would consequently have been saved. If water had got into the vessel inside of the ceiling, the slates and it would not have choked the pumps, although she had not been fitted with either percolators, or dunnage battens and boards. Would it not therefore be sound policy, considered merely as an abstract question of safety to property, even supposing lives were not at stake, to guard against similar dangers in future, by caulking the whole of vessels' ceilings, which might be done at an expense of a few shillings per ton. Saving outlay is not always economy or the best policy.

In looking over a list of Merchant shipping employed in the various carrying trade of the world, it will be found that the vessels which carry cargoes that would choke the pumps, and consequently would require to be fitted with percolators, form only the exception, and not the general stock, and it is unnecessary to enumerate them, because they point out themselves by asking the question, Has this vessel in any thing which would choke her pumps?

To recur again to the advantages of uniting the whole timbers, and to prove the *strength and safety* it would give to vessels, suppose a carpenter sent to scuttle a vessel under the present construction, and one with the timbers united. Under the present construction he has only to lift a limber board, if accessible, or cut up a piece of the ceiling, bore a few auger-holes through the outside plank, and the job is complete. But with a vessel with the timbers united he has no alternative but to cut or bore through ceiling, timbers, and outside plank, till he arrives in like manner at the outside of the bottom.* Uniting the timbers would also be an additional defence against shot.

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* Filling in, or uniting the timbers up to the gunwale, was recommended by the learned and ingenious Baron Charles Dupin in his "Voyages dans la Grande Bretagne," and in the model-room, at the Navy Office, which I have seen by the kind permission of Sir Robert Seppings, I observe the model of a brig called the "Lady Nelson," built on a plan of Admiral Schanks, about the year 1790, with the timbers united, which vessel was running in 1820, and was

Having thus shewn the advantages of two additional securities as high as the decks, and one additional security over them against leaks, let us next proceed to shew the advantages the solid form would give against the hitherto irresistible element of fire. Under the present construction there is a vacancy between the frame timbers and filling-in timbers, which in the case of fire, acts as a funnel or chimney and furnace, to supply the fire with air, and consequently to assist the combustion; but with a solid bottom and sides, these vacancies acting as furnaces and funnels, would all be filled up, and consequently the fire must either burn the inside and outside planking and timbers, all simultaneously, or die out for want of vent. It would thus of necessity be much easier extinguished.

Had the Kent Indiaman, which caught fire a few years ago in the Bay of Biscay, with the 31st regiment on board, and who were only accidentally preserved from a watery grave when the ship was burnt, been built on this construction, the probability is that, under Divine Providence, the fire might have been extinguished, and the ship

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then sound, and made a voyage to Botany Bay, and is now stationed there, and a good account has been received of her, in answering every purpose she was intended for, and tight as a bottle. There is no explanation, however, how the water-courses are constructed, or how a space is provided to hold water in if it gets into the vessel, without its lying amongst the cargo. This vessel had also three sliding keels.

might have pursued her voyage. The Rapid steamboat was burnt in Kirkaldy Roads a short time ago, and which vessel might also have been preserved had she been built in a solid form from kelson to covering-board.

The knowledge that their vessel was built in this way would always, of itself, inspire the greatest confidence in a crew when their vessel was in danger either from water or fire, and consequently animate and stimulate them to the greatest exertions, when they saw a reasonable probability of preserving their lives and effects, and the vessel and property committed to their charge. Contrast this with the present structure where, so soon as a rock or anchor has pierced the outside plank, or the vessel has sprung a leak at sea through the outside plank, or the vessel takes fire, all is at once next to hopeless.

Besides the good effects of having no receptacles for bilge-water and vermin,* and being enabled by carrying the bottoms of the pumps below the level of the bilge-water, to take it all out of the vessel except a few buckets full, and an index to shew by inspection on deck when there was any water in the vessel, and the other advantages before mentioned, it would always be practicable when the cargo was out, to stop leaks from the inside, and thus, in distant ports, often save the heavy expense of heaving the vessel down, and a vessel would always shew a leak on the inside, if under the line of floatation, by taking off the dunnage-boards and battens, if she was fitted with them, and if necessary to do so.

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* Much waste and damage is frequently done to vessels' cargoes by rats and mice, all of which would be prevented by the solid form, as there would then be no harbour for them between the timbers and inside and outside planks.

Assuming then, that the advantage of caulking the whole ceilings of vessels already built, and of uniting the timbers into one compact water-tight frame of those to be built, are admitted, let us next consider of the objections to the plan.

The first objections of want of space to hold water in, or taking away from the stowage, are, I trust, already satisfactorily disposed of.

The next objection, that the solid form would cause vessels to draw more water, is at once admitted; but in the opinion of ship-builders it would not much increase their draught of water; and although it might be objectionable to such vessels as carry coals, lead, iron, or any cargo which would overload a vessel, yet these vessels only form an exception to the general carrying trade, while the advantages to all vessels, of having additional weight in the bottom of their fabric, operating as ballast, would far outweigh the disadvantages to a few vessels. Even these vessels, when they were light, would find the advantages of having additional weight in the bottom.

The next and most important objection, and perhaps the only real one, is the expense, which however, I have reason to apprehend, is much over-estimated.

If it be only to caulk that part of the vessel's ceiling, including the limber boards, which is at present uncaulked, and put in an additional pair of pumps, with a cistern under the bottom of them, in vessels already built, all this may, it is presumed, be done at little expense; and even to fit the vessel either with percolators, as far forward and aft as her present water-courses, or to fit her with dunnage battens and boards, would not be very great.

As to the further plan of uniting the timbers of new vessels, it is the opinion of ship-builders, that if the price of the hull be divided into three parts, one of these parts would cover all additional expense, and complete the vessel with dunnage-battens and boards, or percolators, and the timbers either united or filled in, and caulked inside and out, and the ceiling caulked, &c. For instance, if a good vessel should cost £9 per register ton for the hull, under the present construction, £3 more, or £12 per ton, would complete her in this way. Allow, according to the general rule, that the price of the hull is only half the total cost of the vessel, when completed for sea, say £9 per ton more for outfit; total when complete in this way £21, instead of £18 per register ton.*

Assuming then that one-sixth part of the whole cost would cover the additional expense of completing the vessel, would it not be sound policy, and eventually economy, to disburse it? It is only upon the hull that the additional expense would be laid out, as the masts, sails, and general outfit would be the same as before. To shew the advantages of the additional outlay in a stronger light, what would be thought of the policy of building a bridge, or a warehouse, for £1,800, when one possessing additional strength, safety, durability, and protection against fire, could be built for £2,100, even although the additional safety to lives was not taken into account?

But, whatever the expense may be, if the principle should be approved of by merchants and the the public, whose lives are at stake (and the principle is approved of by scientific and professional men), I venture to predict that the expense must be incurred. *Public safety demands the adoption of the principle, and it must be adopted.* A merchant, or a passenger, has only to say to a ship-owner, I approve of this principle as giving greater security to the safe transmission of my goods or myself, will you carry them or me in a vessel built on this principle or not? If the ship-owner says no, the merchant or passenger has only to remark, that he will find some person who will.

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* These prices are for the out-ports, and if a third of the cost of a low-priced vessel, would cover the additional expense, it would not require the same proportion of a high priced vessel, the principal additional expense being in labour.

Since writing these remarks, the loss of the Rothesay Castle steamer has occurred, on the coast of Wales (17th August, 1831), with the loss of about a hundred human lives of passengers and crew on board of her. The owner has most properly obtained and published a certificate from the ship-builders who repaired the vessel, certifying that she was tight, staunch, and strong, and sea-worthy, when she commenced the voyage; and yet, in the course of her passage, in no very tempestuous weather, she sprung a leak, which seems to have been the original cause of the loss of the vessel; and after she grounded on the sand-bank she broke up, and went to pieces in the course of two hours. Can any thing place in a stronger view the defective construction of steamers and merchant shipping generally, for the hulls of them are all built on the same defective principles? A certificate of sea-worthiness, and being tight, staunch, and strong, may at present be obtained for any fabric which can be made to float on an inch and a half, or a two inch plank, and, indeed, after the most careful surveys inside and out, it is often impossible to discover any insufficiency of the vessel, owing to the defective construction and bad principles on which vessels are built.* Now

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* "With respect to the sea worthiness of ships, the most important cases have arisen in questions of policies of insurance. There is, indeed, little distinction to be made between the nature and extent of this obligation from the merchant to the insurer, and that from the ship owner to the freighter. We have said that, independently of the covenant in the charter-party, which only re-affirms and strengthens the general obligation, there is a tacit and implied agreement that the ship shall be sea-worthy, and capable of conveying the goods in proper condition. It is not sufficient that the owner did not know that the ship was *not* seaworthy; for he ought to know that she was so at the *time* he charters her. The sufficiency of the ship is the substratum of the contract between the parties, and a ship not capable of conveying the goods in a proper state is a failure of the condition precedent to the whole contract. The seaworthiness of the ship is not a question of fraud or good intention, but it is a positive stipulation that the ship shall be so, and therefore although the owner may himself have been deceived by the ship builder, repairer, &c., if the vessel be, in fact, unseaworthy, have an insufficient bottom or unsound timber, it is a breach of a preliminary condition, and is fatal as such to the contract. In Eden *v.* Parkinson, which was a case on a policy of insurance, Lord Mansfield said, 'by an implied warranty, every ship insured must be tight, staunch, and strong, but it is sufficient if she be so at the time of her sailing. She may cease to be so in twenty-four hours after departure, and yet the underwriter will continue to be liable.' But if a ship sail upon a voyage, and in a day or two become leaky and founder, or is obliged to return to port without any storm, or visible or adequate cause to produce such an effect, the presumption is, that she was not seaworthy when she was let out to freight, or sailed, and the jury may draw this conclusion. The principles of law applicable to the implied warranty of seaworthiness, whether as respects the mer-

I venture to assert that had this vessel been filled up solid between the timbers, and had her ceiling

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chant, freighter or insurer, have lately been fully recognised and adopted by several cases upon appeals from Scotland, in the House of Lords. The facts of those cases are not material, but in one case, with reference to a policy of insurance, and by analogy, therefore, to a contract of charter-party for freight, it was stated to be a clear and established principle, that if a ship be seaworthy at the commencement of her voyage, though she become otherwise in an hour from that time, the warranty is complied with, and the under-writer liable.

"But in the same case it was also said by two Noble Lords, 'That when the inability of the ship to perform the voyage becomes evident immediately after leaving port, or in a short time after the risk commences, without any apparent cause of injury, the presumption is that this inability has arisen from causes existing before her setting sail on the intended voyage, and that the ship was not then seaworthy; and the *onus probandi* in such a case is thrown upon the owners to shew that the inability arose from causes subsequent to the commencement of the voyage.' But as every man is presumed to know his duty, and to discharge it, it is a presumption of law, that every ship, whether chartered or insured, is seaworthy; and the negative is to be proved in an action against the owner. The decision therefore in the above case does not impair the doctrine, that the ship is *prima facie* to be deemed seaworthy; but merely, that when a ship, soon after sailing, is found unfit to proceed, the question must be decided by some evidence or natural inference from the circumstances. In the House of Lords it has also been adjudged, that a vessel cannot be deemed seaworthy for a foreign voyage *without knees*. The other terms, 'perils and dangers of the seas, and accidents of the seas, rivers, and navigation,' are to be understood of all such accidents as arise from the sea and winds, and which could not be prevented or avoided by any care, vigilance, or skill of the master or mariners; such accidents are inevitable, and in no degree occasioned by ignorance, wilfulness, or neglect of the navigators.

been caulked, this calamity would not have happened. Independent of the preservation of the lives, would it not have been for the interest of the owner or under-writers, that this had been done, whatever it had cost ?[*]

While I am writing, another melancholy shipwreck is announced. The Lady Sherbrooke, in the entrance of the gulf of St. Lawrence, where *two hundred and forty one human lives have been lost.* This appears also, by the master's letter, to have happened in no very tempestuous weather, as they were preparing to tack when the vessel struck, on the 19th July, the very finest season of the year, and on the 20th the vessel went to pieces, and all these lives were lost. Now had this been a ship of war, with a solid bottom, the probability is, that in the same circumstances, this would not have happened. But one fact in point, on this head, is worth a thousand arguments. On or about the same ledge of rocks on which the Wolf sloop of

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"But where the damage or accident alleged to have happened from the peril of the sea, has not properly arisen from any natural effect of the winds and waves, such as from tempest, high seas, rocks, collision, or leakage, the cause must be specially stated, and in its proper terms, in the pleadings."—*Holt's Shipping and Navigation Laws, Second Edition.*

[*] "Milford, March 19, 1831.

"The Frolick steam packet, Jenkins, from this port to Bristol, was totally wrecked on the Ness Sands, on Wednesday night, and all on board drowned. It is supposed she had forty passengers. Nothing saved but the steam engine and boiler."—*Lloyd's List.*

war struck, and lay fast for two nights and a day, in March, 1830, at the back of the Isle of Wight, the vessel, at the time she struck, going at a considerable rate through the water, at the very top of high water, of a high spring tide, and with a considerable swell on, and which vessel was got off again, and is now in the East Indies, having been dragged over the rocks for half a mile, by assistance from Spithead, the vessel beating very hard upon the rocks with the lift of the sea all the time, the Carn Brea Castle, free trader to India, was lost only a few months before, having got ashore under more favourable circumstances for getting off again.* What could this be owing to? The ships were nearly, I believe, of similar tonnage. The answer is plain and obvious. The Wolf had a solid bottom of fifteen inches thick at the keel, being twelve inches of timbers, and three inches of outside plank, without allowing her to have had any ceiling. The Carn Brea Castle would only have an outside bottom plank to protect her, of, I presume, three inches thick. Yet this vessel would have timbers of twelve inches thick, if not more, and a ceiling plank of, I also presume, three inches thick, making three inches more than the sloop of war, but neither of which were of the least use to her in keeping out the water. Had her timbers been close, and her ceiling been caulked, she would have had one more protection than the sloop of war, viz. the ceiling plank, without taking any thing from her stowage, and the fair inference is, that she would have been got off and preserved.

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* "Cowes, 6th July, 1829.

"The *Carn Brea Castle,* Barber, from London to Bengal, got on shore last night, near Mottison, the south-west part of the Isle of Wight, with main and mizen masts cut away, where she lies full of water, and it is feared will become a total wreck. The passengers are landed: the captain and crew remain on board."—*Lloyd's List.* The first intimation from Lloyd's, that this vessel is ashore, contains also the information that she is full of water. Is it probable this would have been the case, if the vessel had had a solid bottom?

The simple question, when stripped naked, is, whether from two to five inches of plank, with the grain of the wood all running in one direction, be as good a defence against water or violence as from twelve to twenty inches, in three separate parts, united into one, with the grain of the different pieces of wood, placed transversely to each other, and consequently in the strongest possible manner. Common sense says not, and controvert it who may—confute it who can!

Whatever rules or laws may be enacted or adopted for the better regulation of vessels carrying passengers, and for the safety of property embarked on board of them, and however proper and judicious they may be, and rigorously enforced, I presume to think they will and must prove ineffectual, except as secondary measures, and that nothing can cure the evil without going to the root of it, and amending the defective construction of merchant vessels, including steamers, and that

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whatever may be done till then, all precautions and safeguards must be in vain.

The public seem to be satisfied with an opinion that the Rothsay Castle was rotten. Be it so; and let them and the owner reconcile the circumstances of being at once rotten and seaworthy, as they best can. Were the Spring, His Majesty's ship Agamemnon, the Mind, the Carn Brea Castle, the Frolick, and the Lady Sherbrooke, all rotten? It must be remembered too, that these instances are given merely because they have already been pointed out; and to quote cases where vessels with their passengers, crews, and cargoes have been lost, which in exactly the same circumstances might, under Divine Providence, have been saved, had the vessels been built with solid bottoms and sides, would be to quote nearly the whole of Lloyd's List, and this allegation is proved by the fact of His Majesty's ships being preserved in circumstances where merchant vessels are lost, not owing to more effective powers on board of ships of war, as they also used frequently to be lost (for a few instances see note to following page), but owing to their solid bottoms. If the evil be closely investigated, it will be found to lie, not so much in the rottenness of the fabric, as in the system of building. It should also always be borne in mind, that whatever will give security to life afloat will give security to merchandize, and *vice versa*.

I shall conclude these Remarks, by observing, that in looking over the shipwrecks in "Duncan's Mariners' Chronicle," in six volumes, by far the greater part of them had originated in leaks;* that the shipwreck of the Britannia, the subject of Falconer's beautiful poem of "The Shipwreck," originated in a leak, and which, in all probability, might, in exactly similar circumstances in all other respects, and even with an inferior crew, and under Divine favour, be prevented from happening again, by uniting the timbers and caulking the ceiling; that the use of solid bottoms would have gone far to have prevented all the founderings, where, as in the case of His Majesty's ship Centaur, which ship sunk in the Atlantic ocean, with all her crew, except twelve persons who escaped in a boat; and the many cases in which no individual has been spared to tell the tale, in consequence of leaks, where,

> "Still all our pow'rs th' increasing leaks defy;
> We sink at sea, no shore, no haven nigh;"

and most of the shipwrecks under the present construction, and in similar circumstances to the

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* The Ramillies, Centaur, Glorieux, and Ville de Paris, all foundered with the greater part, and some of them with the whole of their crews, coming home from the West Indies in 1782, by springing leaks, without striking on rocks; and the origin of the loss of the Royal George, with her crew, at Spithead, in the same year, (though not the immediate cause of the loss,) proceeded from a leak, and similar losses it may be presumed may be again prevented in similar circumstances, by having solid bottoms and caulked ceilings, and

Frolick, the Rothsay Castle, and the Lady Sherbrooke, where

> "Should once her bottom strike that rocky shore,
> The splitting bark that instant were no more;
> Nor she alone, but with her all the crew,
> Beyond relief were doomed to perish too;"

which have happened since the time of Noah's ark; that the adoption of them yet may be the means of saving thousands of lives and millions of property, as "a preventive is in every case better than a cure;" and that the preventive may be obtained at no unreasonable or extravagant expense.

I am not to be understood as saying, that vessels would be guaranteed from shipwreck, as there are circumstances where vessels would be knocked to pieces although they were made of solid iron or steel; but I venture to assert, that a vessel with a solid bottom would be much longer in being knocked to pieces than without it; and, consequently, by holding longer together, give a much greater chance of preserving the crew, passengers, and property,* and that a vessel which has her

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consequently a security against leaks equal to the whole thickness of the fabric; and it may be observed that the same defective construction which caused the loss of these vessels, is producing the same effects in the merchant service at this very day.

[*] In cases of collision too, like the Comet steamer, which was run down in the entrance of the Clyde, in 1825, and a number of lives lost in her, a vessel with her timbers united, and all as solid as a bomb-proof wall, would be much stronger to resist a shock than she would be under the present construction.

ceiling and limber boards caulked and water-tight, contrasted with a vessel which has not, has virtually, in point of safety against leaks, two bottoms instead of one, with the additional advantage of the ceiling being much better protected from damage or injury than the outside planking.*

A proper and just method of estimating the expense and advantages, is by taking a retrospective and a prospective view of shipping.

Assuming then, that nearly all the vessels which have been lost by foundering, fire, and collision, and many of the vessels, and much of the property, which have been lost by shipwreck, such as the Rothsay Castle, and Frolick, steamers, Carn Brea Castle, Lady Sherbrooke, &c. might have been saved if the vessels had had solid bottoms, and it seems indisputable, it will amount to probably fully a third (some think more) of the whole shipping and property which has been lost, and which might have been saved, besides the lives. Let us therefore take a date, and see what this would have amounted to since 1780, or fifty years ago. Had vessels' bottoms been made solid then and since, at an additional expense to the owners, on which side would the balance of gain have now lain? Would it not have been millions of money saved to them and merchants, besides the lives? Continue to build merchant-vessels, including steamers, as at present, with only the outer planking to keep out the water, and the same fatal consequences will inevitably ensue, and lives be lost, though the vessels should be loaded with as many safety-boats and life-preservers as they could stow, or carry. On the other hand, build them solid throughout, and many lives and much property will unquestionably be saved.

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* I have heard much of the difficulty there would be in keeping the ceilings of East Indiamen tight, on account of the trying cargoes of pepper, cotton, &c. which they have occasionally to carry, causing the planks to shrink. I have lately been on board of the Canning, Sir David Scott, William Fairlie, Asia, Windsor, and Protector, (hired ship,) some of which were, I am informed, upwards of twenty years old, and I cannot see the difficulty. Admitting the planks to shrink, the interstices might be filled up with Roman cement, or the other substances mentioned, and fillings, which would oppose the entrance of water as much as the solid plank, and thus give the vessel a double bottom; but, even supposing the ceiling too much shrunk or decayed to render it advisable to fill in or repair it, a ceiling of well seasoned foreign fir may always be put in at no great expense, which would add much to the strength of the vessel and also give her a double bottom. While a vessel's ceiling is used only as a platform, there is no object in keeping it tight, and it is consequently neglected.

" *We hereby certify these to be the same remarks to which our Certificate of the* 31*st of May refers, with such additional circumstances added as have happened since then.*

" *Given under our hands this sixth day of September, Eighteen hundred and thirty-one.*

" JOHN GRAHAM,
Carpenter Royal Navy,
ANDREW ADAMSON,
Carpenter Royal Navy."

APPENDIX.

THE FOLLOWING ARE COPIES OF CERTIFICATES, LETTERS, AND RECOMMENDATIONS, IN FAVOUR OF THE PLAN.

We whose names are hereunto subscribed, having read over Mr. Ballingall's Remarks on the filling-in between the timbers of vessels, planking and caulking their ceilings, &c. with a view of adding to their strength, safety, and durability, and having seen a plan and model of the percolators, are of opinion that if the plan were generally adopted, in both the Royal and Mercantile Navy, it would be attended with the good effects expected from it, as described in the Remarks.

We beg leave to state, that we are quite satisfied of the strength, efficacy, and practicability of the percolators, for all useful purposes, and would recommend the general adoption of them, and the whole plan both for new and old vessels.

With respect to sand ballast we are of opinion, that there would be fully as much protection by the percolators, against the pumps being choked, as there is under the present construction of vessels.

We further certify, that the plan was new to each of us when we first heard of it from Mr. Ballingall, except the part of filling-in and caulking between the timbers of vessels, as at present in practice in the Royal Navy (and which is so acknowledged by Mr. Ballingall in the quotation from the Encyclopedia); and, with that exception, we believe the whole design and plan to be original, and of his own invention.

We also highly approve of the plan of making vessels shew whenever there is any water in them at both the main and bilge-pumps, together with the quantity in the vessel at the main-pump, by a self-acting marker, which we also believe to be original, and of Mr. Ballingall's own invention; at least it was new to each of us.

Kirkaldy,
31*st May*, 1831.

On the 20th of October this Certificate was signed by 2 Commanders, 4 Masters, 4 Carpenters, 1 Surgeon, and 2 Gunners of the Royal Navy; 1 Major of the Royal Army, 2 Officers of the Honourable East India Company's Naval Service, 3 Ship-builders, 12 Shipwrights, 5 Ship-joiners, 1 Ship-breaker, 40 Ship-owners, 79 Ship-masters, 9 Ship-agents and Managers of Shipping Companies, 2 Ship and Insurance Brokers, 17 Ships' Tradesmen of various professions, 2 Surveyors for the Register Books of Shipping, 4 Civil Engineers, 28 Merchants, 3 Mates, and 1 Pilot. Total, Two hundred and twenty-two.

Copy of a Letter from John Robison, Esq. F.R.S.E. Secretary to the Royal Society of Edinburgh, to Sir George Ballingall, Professor of Military Surgery, in the University of Edinburgh.

Edinburgh, 9, Athol Crescent,
30th June, 1831.

Dear Sir George,

I return Mr. Ballingall's papers, which I have read with much interest. It appears to me, that when the first expense is not objected to, there can hardly be hesitation in adopting a plan, in which, the whole of the materials employed in the hull of a vessel is made to answer the double purpose of keeping out the water and increasing the strength of its fabric; while, by the usual method of construction of merchant vessels, two thirds of the materials are unavailable for keeping them water-tight.

I believe it is now generally acknowledged, that the dry rot, whether on shore or afloat, is generally propagated in situations where stagnant air is liable to be impregnated with putrescent matter. The plan of making a vessel's bottom in one solid frame, will have the effect of doing away all lodging places for air, and will therefore prevent dry rot from originating in the vessel, and may even check it, should the germ exist in any part of the materials employed in building. I have been informed at the Navy Office, that this effect has followed the solid method of building, which has been introduced into our ships of war.

The Swallow Packet, which belonged to the East India Company, had the spaces in her bottom filled in with a mixture of chuna and jaggerie, (fine lime and treacle,) and when I happened to be on board of her, (when she was upwards of 50 years old,) she made so little water, that it was necessary to take it in, in order to wash out her hold.

I am, dear Sir George,
Very truly your's,
(Signed) JOHN ROBISON.*

SIR GEORGE BALLINGALL,
13, Heriot Row, Edinburgh.

Copies of Letters from the Navy Board to Mr. Ballingall.

(ON HIS MAJESTY'S SERVICE.)

Navy Office, 31st August, 1831.

SIR,

The Lords Commissioners of the Admiralty having referred to this department your letter of the 13th instant,* suggesting a method of giving increased solidity to the frames of ships, I am commanded by the Commissioners of the Navy to acquaint you, that if you have any plans or models to submit to the Board descriptive of the method in question, they will give them every consideration; but they wish it to be distinctly understood, that any expense connected therewith must not be borne by the public, but must be entirely at your own charge.

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* Mr. Robison begs to suggest, whether strong copper wire cloth, *tinned after weaving,* would not be better for percolators, than pierced plates.

I am, Sir,
Your humble Servant,
(Signed) G. SMITH,
(Secretary to the Navy Board.)

Mr. BALLINGALL,
Kirkaldy, Fifeshire.

(ON HIS MAJESTY'S SERVICE.)

Navy Office, 21st September, 1831.

SIR,

I am commanded by the Commissioners of the Navy to acknowledge the receipt of your letter of the 19th instant, and to acquaint you that your models for the improvement of ship-building will be inspected by Sir Robert Seppings, the Surveyor of the Navy, if you will attend at this office on Friday next, at half past ten o'clock.

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* On the 13th of August, Mr. Ballingall had the honor to suggest to the Lords of the Admiralty, the advantages, in point of safety, which would accrue to transports, &c. from having close timbers and caulked ceilings; and to steamers, from having, in addition to the above, a water-tight platform under the boilers, and water-tight cabin and forecastle bulkheads and decks.

I am, Sir,
Your humble Servant,
(Signed) G. SMITH,
(Secretary to the Navy Board.)

Mr. JAMES BALLINGALL,
Hore's Wharf, Hermitage Bridge.

Copy of a Letter from Sir Robert Seppings to Mr. Ballingall.

Navy Office, 23d September, 1831.

SIR,

I have inspected your proposal for giving greater strength to mercantile ships, and additional protection to their cargoes, and am of opinion that these objects will be obtained thereby, to a greater extent than by the present usage. At the same time I am of opinion that the expense in constructing ships on the proposed system will be considerably increased, when compared with the present practice.

I am, Sir,
Your obedient Servant,
(Signed) RT. SEPPINGS.

Mr. BALLINGALL.

Copy of a Letter from Mr. Ballingall to John Knowles, Esq.

52, Wellclose Square, 21st October, 1831.

Sir,

I would feel particularly obliged, if you would do me the favour to inform me of a few recent cases, consistent with your knowledge, of the solid bottoms of vessels, and the exclusion of air, tending to the preservation of timber. I make no doubt of this being the fact, but I am so constantly met with affirmations to the contrary, that I am anxious to have it in my power to point out a few cases where there can be no dispute, being facts and undeniable. Trusting you will do me this favor, and excuse the liberty,

I am, Sir, respectfully,
Your most obedient Servant,
(Signed) J. Ballingall.

J. Knowles, Esq.
Navy Office.

Copy of Mr. Knowles's Answer.

Navy Office, 24th October, 1831.

Dear Sir,

In answer to your letter of the 21st instant, I beg to state that there are many instances in the

Navy of ships having been saved in consequence of the introduction of solid bottoms. Those which I now recollect are the Barham, Pylades, Vigilant, and Success. Within a few days a drawing has been received, shewing the damage which the latter ship received when she was ashore in Cockburn Sound. The whole keel was carried away; the lower piece of stem also; five feet, four inches of the stern-post, and four pieces of the dead wood; nine strakes of the bottom were off amidships, and many strakes in the bows, and yet this ship was floated off.

The whole Navy proves that the ships with solid bottoms have been more durable than they used to be when openings were left.

I am, dear Sir,
Your very obedient Servant,
(Signed) JOHN KNOWLES.

JAMES BALLINGALL, ESQ.
52, Wellclose Square,
St. George's in the East.

Copies of Letters from the East India Company to Mr. Ballingall.

East India House, 6th October, 1831.

SIR,

I have laid before the Committee of Shipping, your letter of the 3d Instant, (with an inclosure from Mr. Serjeant Spankie,) relative to a plan invented by you, for improving the construction of merchant vessels; and I am directed to acquaint you that the Committee will meet on Wednesday next, the 12th instant, at 11 o'clock, when an opportunity will be afforded you, of laying your models before them, and of explaining the principles thereof.

I am, Sir,
Your most obedient Servant,
(Signed) WM. GUNSTON.
(Clerk to the Committee of Shipping.)

Mr. JAMES BALLINGALL,
52, Wellclose Square,
St. George's in the East.

East India House, 28th November, 1831.

SIR,

I have the commands of the Committee of Shipping to acquaint you, in reply to your letters of the 31st ultimo, and 18th instant, relative to your plan for an improved mode of building merchant vessels, that the Committee have no doubt great additional strength would be given to vessels built according to your plan, but that the expense would be much increased.

I am also to add that the Committee have not an opportunity of giving your plan a trial.

I am, Sir,
Your most obedient Servant,
(Signed) **Wm. Gunston.**

Mr. James Ballingall,
Kirkaldy, Fifeshire.

Copy of a Paragraph from the Scotsman Newspaper of Sept. 7, 1831.

Steam-boats.—The loss of the Rothsay Castle has drawn public attention to the faults in the construction of these vessels, and various plans for giving them additional strength or security have been suggested. Among others, Mr. Ballingall, of Kirkaldy, who has had much experience in the management of shipping, strongly recommends certain improvements, of which a great number of nautical men have expressed themselves in the most favourable terms. Mr. Ballingall is preparing a small tract upon the subject; and according to the advertisement which appeared in our last, his plan consists "in uniting the whole timbers of the vessel, including the stem and stern post, into one compact water-tight frame, and caulking their ceilings, including the limber boards, from the kelson to the covering board." Some of these terms are Hebrew to us; but we understand that at present the security of a steam vessel depends entirely upon the exterior covering of her sides and bottom, and that if this opens or yields in any part, the water finds an immediate passage into the hull. Mr. Ballingall proposes in the first place, that the ceiling or interior lining which is now left open in the seams, should be *caulked;* in which case, though the outer covering of the vessel should yield, the sea would still be excluded by an inner water-tight one; in the second place, he proposes to fill up the vacant space between the interior ceiling and the exterior planking, which is at present a receptacle for vermin and bilge water, and thus by giving the vessel a greater degree of stiffness and strength, to make her more able to resist the straining occasioned by a heavy sea. With these leading improvements, he combines several others, one of which is a self-acting index to exhibit the quantity of water in the vessel.

INSTANCE OF THE ROYAL ADELAIDE STEAM VESSEL, BUILDING AT LEITH, ON THE PLAN, IN A LETTER FROM THE MANAGING OWNERS.

I have said, in the list of advantages to the ship-owner and merchant, that the plan was coming into practice, and I have now the pleasure to publish the following letter from Messrs. Ogilvie and Crichton, Leith, managing owners of the Royal William and Royal Adelaide steam ships, intended to ply on the passage between Leith and London; and as a good example in point of safety to passengers is thus set, I trust it will be speedily and generally followed.

Leith, 17th January, 1832.

DEAR SIR,

The Committee of Owners of the Royal William and Royal Adelaide steam ships, have attentively considered your plan of filling in the timbering of ships' bottoms, solid up to the load water line, and desire us to acquaint you that their new vessel, the Royal Adelaide, is in most respects built on the plan which is now recommended by you, and that she has the floors and first foot hooks laid solid amidships, and filled up with chocks and caulked, both outside and inside, forward and aft, before planking; and we have no doubt that the same plan will be adopted in any vessels which they may hereafter build.

We are, dear Sir,
Yours truly,
(Signed) OGILVIE & CRICHTON.

JAMES BALLINGALL, ESQ.
Kirkaldy.

The Earl of Kellie, steam packet, belonging to the Fife and Mid-Lothian Ferry Trustees, and plying on the Frith of Forth, had bilge pieces fitted to her last summer, and is very much strengthened and improved thereby.

It is right to state that, in my evidence before the Steam Navigation Committee, I alluded to the Victory and Rapid steamers, the outside and bottom planks of which latter, when she was burnt (as mentioned at page 90), were only inch and half thick, and was all that was between the passengers, when she was on the ferry, and the water, and probably eternity.* The public will have themselves alone to blame, if such vessels continue to ply on ferries, which are exposed occasionally to heavy seas.

The Ferry Trustees' steam boats are as strong and good vessels as any I know of, which are built on the same construction.

LETTER FROM THE HIGHLAND SOCIETY OF SCOTLAND WITH THANKS AND SILVER MEDAL.

The models illustrative of the plan which were submitted to a Committee of the House of Commons, sitting on the Improvement of Steam Navigation, were presented to the Highland Society of Scotland, and the following is a copy of a letter from Charles Gordon, Esq. their Secretary.

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* We here get at Shylock's meaning, that "ships are but boards;" but whether he alluded to steamers, seems still to be in the dark, as they were not greatly in vogue in his day.

Highland Society Hall, Edinburgh,
17th January, 1832.

SIR,

I have the honour of intimating to you, that I have laid before the Directors of the Highland Society of Scotland, and also before the Society, at their general meeting on the 10th instant, your letter of the 3d, soliciting permission to deposit in the Society's museum, four models, illustrative of plans proposed by you, for improving the construction of steam vessels and sailing vessels, and at the same time requesting that the original certificates of practical men, expressive of their opinion of the advantages of your improvements, may be deposited in the Society's archives for preservation.

The Society, in pursuance of the recommendation of the Directors, have granted the permission requested by you; and further, in respect that steam navigation is in various ways highly conducive to the agricultural prosperity of the country, I have been directed to convey to you the thanks of the Society, and at the same time to present to you their Silver Medal, for the communication made to them of the improvements proposed.

I have now, accordingly, much pleasure in acquitting myself of the duty with which I was charged, and have the

Honour to be, Sir,
Your most obedient Servant,
(Signed) **Charles Gordon,**
(Secretary to the Highland Society of Scotland.)

James Ballingall, Esq.
Kirkaldy.

The following most judicious letter appeared in the Times newspaper, of 19th September last, and although I am a stranger to the author, and we are not exactly at one, as to the method of ascertaining the sea-worthiness of steam or sailing packets, yet our objects are the same, and I take the liberty of re-publishing it, pleading the motives of public safety intended, if any apology be required.

STEAMERS.

To the Editor of the Times.

Sir,

The dreadful loss of lives occasioned by the wreck of the *Rothsay* steamer, has naturally produced a great excitement in the public mind, and led to many suggestions, which however well intended, are utterly impracticable. No steamer, for example, can possibly carry boats enough to take in all the passengers and crew, in every case, since some of the smaller vessels often have on board 120 to 150 persons. As for stuffing them round with life preserver mattresses, your correspondent J. B. Hall, has sufficiently shewn the absurdity of such an idea. All that the legislature can do, in the way of prevention of such dreadful accidents as that which occurred to the *Rothsay Castle*, is to secure the sea-worthiness of the vessels employed as packets, and the efficiency, professional and moral, of the commanders and officers. To effect this desirable purpose, it is merely necessary to subject all of them to periodical survey and investigation, say half-yearly, and to make it incumbent on the master to produce a surveyor's certificate at each time of sailing. For the duties of surveying the vessels, and making enquiry into the nautical qualifications, and the sobriety of the masters and mates, carefully selected officers should be appointed at every port. Many half-pay officers of the navy would be found capable in every respect of the duty, and glad to undertake it at a very moderate remuneration. That remuneration should be paid by the owners of the vessels, for their half-yearly qualifications, say a guinea for each, or two guineas a year. The certificates would, of course, include the names of the captains and mates; and the owners should be compelled to notify any change in them, that the requisite alteration might be made, without, however, any additional charge. It would, of course, be understood, however, that the surveyors should have a right of surveying at all times, for reasons sufficiently obvious; and that no vessel should be permitted to sail, if the surveyor at any time reported against her to the collector of customs, until the objection, whatever it might be, should be removed. You may rely on it, Sir, that a regulation of this kind, would do more to prevent the loss of steamers than piling them up to their chimney tops with life-preservers, for there can be no doubt that, when well-built, and seaworthy, and well officered, the danger of wreck in them is utterly insignificant in short voyages.

I am, Sir,
Your's, &c.
A SEAMAN.

To prevent the collision of steam vessels at sea, or wherever there is room for the manœuvre, the American rule is simple and most effectual. Each vessel, in case of danger of collision, is ordered to put her helm a-starboard, (a-port would do as well,) and both consequently sheer entirely clear of each other.

CASES IN POINT, SHEWING THE DEFECTIVE CONSTRUCTION OF MERCHANT VESSELS AT PRESENT.

I here give a few cases, consistent with my own knowledge, of the present defective construction of merchant vessels, facts being always better than arguments, and Burns has described them as "Chiels that winna' ding, and darena' be disputed."

A ship in which I sailed to the West Indies in 1814, sprung a leak in running before the trade winds, owing, I presume, to the press of sail which it was found necessary to carry to keep up with l'Aigle Frigate, the convoy. Finding, after getting into port, that the ship made as much water in harbour as she did at sea, and when nearly all the ballast was out as she did when it was all in, I was convinced the leak must be very low down, and apprehended there was little risk of its getting worse, and considered the vessel sufficient enough to return home with a cargo. The planter to whom the ship was consigned, having loaded her the year before, never entertained a suspicion of her being leaky; and as the question was not put to me, and it was none of my business to expose the vessel's defects, no communication of any kind took place on the subject of the vessel being tight. All went on well enough till I had got about a third of a cargo in, when this gentleman, having got intimation that the ship was leaky, sent on board to ascertain the fact, and which I never for a moment attempted to conceal. On his ascertaining what water the ship made, I received an order from him, to deliver to another vessel all his sugars then on board, but with which I declined to comply, as the officers, crew, and myself, considered the ship sufficiently strong to take them to London, their destination, in safety. An attempt was then made to condemn the ship in the Vice-Admiralty Court of the Island, which failed, and I obtained a certificate of the ship being seaworthy, and brought the sugars and other produce in safety to London, and delivered them all in good order, in Blackwall Basin; but it must be confessed they ran a much greater risk of damage in the basin than they had done in the passage home, owing to its being difficult to practise that watchfulness, and give that attention to pumps in the basin, which can be done when the whole crew of a vessel are on board.

A protest was forwarded to London against me, according to the tenor of which I had carried off the sugars violently, surreptitiously, and illegally, and in the event of damage to the cargo, I was to have been tried criminally and capitally at the Old Bailey, as a freebooter, I presume. The owners of the ship also were, by the tenor of the protest, made liable for the value of the property.*

Now, had this vessel's ceiling been caulked, all these unpleasant circumstances would have been prevented, the vessel would have got a full cargo, which was promised and engaged, and much anxiety of mind to all parties, and it must be admitted, risk to property, avoided. Would it not then have been much in favour of the owners, that this had been done, and of what consideration would the expense of doing it have been, when placed against the advantages of a full, instead of a third of a cargo, while all expenses were incurred to nearly as great an extent as if the vessel had got a full cargo? Besides which, the vessel would have had a double bottom in all time coming, so long as she lasted. I only extremely regret that it did not then occur to me to do it.

A new ship in which I sailed to the East Indies in 1818, her first voyage off the stocks, was found, like many other new vessels, to be leaky, and as she was coppered on the stocks, before she was launched, there was no getting at her bottom to caulk it, without stripping off the new copper, which, in addition to the expense, would have lost the voyage for which she was engaged, owing to the detention, as another vessel must have been got to supply her place. This ship being built very sharp aft,* and the pumps being put down by the mainmast in the common way, when she heeled over upon a wind, and there was water in her, not a drop of it remained at the foot of the main pumps, even although she was trimmed two feet by the stern, while it was considerably over the ceiling in the lee bilge, between the fore and main hatchways. In crossing the south-east trade winds, it being necessary to carry a press of sail upon a wind, to weather the coast of South America, it was found that the water did not come to the pumps, and whenever it was practicable, she was put before the wind to pump her out. She had no bilge pumps. It was found, when the chalk which she had in for ballast, was landed at Calcutta, that it was wet two feet above the ceiling in both bilges, having in course of the passage been obliged to carry a press of sail on either tack.

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* Mr. R——y could not be blamed for endeavouring to preserve his property, and he repeatedly said, before I left the island, that he wished he had never heard tell of the ship being leaky; but having been informed of it, he had been obliged to act as he had done; and, notwithstanding that I was carrying off his property against his inclination, I parted with him on good terms.

If this vessel had had in a perishable cargo, sugars for instance, she must have damaged it.* On going up Calcutta river, the pilot got her aground, and partly owing to this cause, and partly owing to the muddy water of the Ganges, filling up the seams and small interstices in the bottom, I presume, she was found, on her return passage, although loaded much deeper in the water than on her outward passage, to be much tighter. I had, however, taken the precaution to put down a large pump forward at Calcutta, knowing by experience that the main pumps would not take the water out, when the ship was on a wind and heeled over, till it was a long way over the ceiling in the lee bilge.

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* She drew four feet more water by the stern than by the head, when launched, with a clean swept hold.

This is another proof of the present defective construction of vessels; for this, as already said, was a new ship, on her first voyage off the stocks, and no care, vigilance, or attention to the pumps, could have prevented her damaging her outward cargo, the first that ever was in her, had it been a perishable one. If this ship's ceiling had been caulked, it would have prevented the water getting within it, and consequently have preserved the cargo. New vessels are frequently leaky, and it is a common thing to take them into dry dock, and fill them with water, to find out the leak. By caulking the ceilings, the practice would be reversed, and it would only be necessary to float them, to find out a leak.

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* A protest was noted, and if the cargo had been damaged, it would have been extended in the usual way, throwing the cause of the damage on stress of weather, instead of the true cause, the defective construction of the vessel.

A first class vessel, indeed nearly new, which lately came under my observation, notwithstanding the owners of her using every exertion, and paying every attention by caulking and otherwise, to keep her tight, and in the best possible order, damaged, first, a cargo of oats; secondly, a cargo of potatoes; thirdly, a cargo of flax; and, fourthly, a cargo of flax; and all without its appearing to be attributable to the fault or neglect of the owners, master, or crew. This vessel was fitted with bilge pumps too, but in bad weather they were nearly if not wholly useless to her, as I have described at pages 40 and 41.

Now again, had this vessel's ceiling and limber boards been caulked, all these damages would have been prevented, and the damages paid, and loss of freight sustained in a single year, would have paid all the expenses of it, and given the vessel a double bottom instead of a single one.

I cannot quit this subject, without adverting to the immense sums paid annually for damages to flax, hemp, grain, seeds, sugars, teas, and indeed all perishable merchandize, the loss of which must be borne either by the merchant, underwriter, or ship-owner, and which very frequently end in law-suits, thus adding fuel to fire, nearly all of which might be prevented by the trifling outlay of caulking the ceilings.* If a vessel has not a good ceiling, she is not complete as a seaworthy vessel under the present construction; and if she has a good ceiling it may be caulked, additional pumps put in, if thought necessary, and all expenses paid, under fifteen shillings per register ton. It is to be hoped, then, when the advantages of a double bottom are balanced and compared against the expense, that this practice will soon become general; and there is little doubt of its saving many lives and much property.

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* By the tenor of a protest, a vessel is always made tight, staunch, and substantial, sufficiently manned, and furnished with every thing necessary for such a vessel and voyage, and in every respect seaworthy, her cargo properly stowed, and her hatches well secured; so that any water which does get into her, must get in, through the bottom, sides, or decks. A tight ceiling would go far to prevent all this. "And the appearer, at all times during the voyage, attended to the pumps, with the utmost care; but at this period, by reason of the vessel lying so much along, from the causes before mentioned, the water frequently remained in the bilge for considerable intervals of time, without reaching the pumps. And the appearer finding this to be the case, occasionally luffed the ship up close to the wind, (or kept her away before the wind, whenever it was practicable, as the case may be,) in order to bring her sufficiently upright to get her pumped out." Pumps which would take all the water out of a vessel, whether she was upright or heeled over, would obviate all this, but it would be better still were there no water to take out.

I would also recommend canvas hoses, to enclose the whole of the masts under the deck, particularly in single decked vessels, to be nailed to the partners of the masts and beams, and to lead all the way down to the step of the masts, so that any water which got in by the working of the mast, would be conveyed down to the bottom of the vessel, without damaging the cargo. This is the more necessary to be attended to, as it is a place where vessels frequently receive water, owing to the difficulty of keeping it tight around the masts.

EXTRACT FROM THE NEW MONTHLY MAGAZINE, RELATIVE TO LOSS OF MERCHANT VESSELS, WITH MR. WATSON'S PLAN TO PREVENT FOUNDERING, BY COPPER TUBES FILLED WITH AIR.

The following is an extract from the New Monthly Magazine and Historical Register, for 1830, vol. 30, pages 25 and 26, on the advantages of copper safety tubes between the beams and timbers of vessels, called *Watson's plan for preventing ships foundering at sea.*

" Having thus exhibited the principle and application of the plan, together with the calculations upon which its efficiency is founded, its importance cannot be more forcibly impressed, than by simply stating the following most appalling facts, as regards both life and property: namely, that three hundred and seventy-three ships and vessels of His Majesty's navy, exclusively of those in battle, have been lost by wreck, by fire, (against which calamity also the plan affords every security, by encouraging the crew fearlessly to scuttle the ship, and thereby to extinguish the flames,*) or by foundering, between the years 1793 and 1826, comprehending a loss of human life to the extent of nearly 8000 of our brave sailors; † and that the number of merchant ships and vessels lost from either one or other of these calamities, averages at the very melancholy rate of one and a half vessel per day in each year, with the attendant destruction of human life to a most awful degree. To prevent the recurrence of an equally afflicting loss of life and property, which

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* Scuttling a ship with the timbers united and the ceiling caulked, would be no easy process, as what would resist violence from without, would oppose obstacles to art from within; but protection against fire would be better attained, if the fire would not burn for want of vent.

† It is but justice to Sir Robert Seppings's plan of solid bottoms to vessels, to state that, such melancholy losses of human life, as occurred in his Majesty's ships Apollo, Athenienne, St. George, Defence, and others, besides those on our own shores, would not happen again, *even in similar circumstances,* as the solid bottoms would longer resist either partial or total shipwreck, and thus give a much greater chance of escape to the crew. Nor is there a doubt on the minds of ship builders, ship carpenters, and seamen, that with such a lower deck as I have described, a vessel in precisely the same circumstances as the Alceste frigate, which was lost in returning from China, with Lord Amherst on board, in the Straits of Gaspar, in 1817, might be preserved.

"It was very soon indeed but too evident, that any attempt to move her would be attended with the most fatal consequences, for may otherwise arise in the progress of time, is the great and important object of the plan,—a plan not of alteration, but merely of addition to the present build of the ship,—one interfering with no room or space of moment, now appropriated to the stowage of cargo, stores, or provisions, nor offering any impediment to the ship's rate of sailing; neither tending to depress her lower in the water, nor requiring attention nor alteration in any state of weather; yet capable of immediate adaptation to the ships of His Majesty's navy, and to merchant vessels."

Page 71. "The immense mass of timber in the build of the ship, when immersed, is available to floatation, and may be thus proved: a cubic foot of oak being, after minute personal experiments, averaged by the late Bishop Watson at 55¾lbs. weight, and as the cubic foot of sea water weighs 64¾lbs., it results that the cubic foot of oak, displacing the like bulk of water, will sustain afloat 9lbs. beyond its own weight, when immersed in water. The same principle holds good

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on each side of the rocks on which she hung, the water deepened from ten to seventeen fathoms immediately around her, and from the injury received, she must have gone down in a few minutes, had she forced her way over this narrow reef. The best bower anchor was therefore let go, to keep her fast; and the pumps were soon abandoned, being clearly of no avail."—*M'Leod's Wreck of the Alceste.*

in different proportions, with the fir and the elm used in the build of the ship, the cubic foot of fir sustaining, when immersed, an extraneous weight of thirty pounds afloat, and a cubic foot of elm twenty-seven pounds."

The reader may make his own application.

GENERAL REVIEW OF SHIPWRECKS.

Let us take a general review of shipwrecks.* A vessel strikes on rocks, or on a sand bank, and lies fast, having no protection or defence in merchant vessels, including the largest East Indiaman belonging to Great Britain, down to a fishing boat, and including merchant steamers, against the admission of water into her, except the exterior covering of the sides and bottom, of whatever thickness they may be composed. By the violence of the wind and sea, the vessel is, in all probability, lifted and dashed against the rocks or sand bank so often, and so violently, that something must at last give way, and either the coverings of the bottom are broken or bruised, the inner edge of the garboard strake forced out of the rabbet or groove in the keel,* or the ends of one or more of the planks are started from their places, and the water flows into the vessel until she fills; and in extreme cases she breaks up and goes to pieces. The passengers and crew either abandon her, if circumstances permit, or are drowned on board; the vessel, if on a sand bank, gets embedded in the sand; or if on rocks, gets so much damage in her bottom as to render it hopeless to get her off, if, indeed, she does not part and separate into pieces; in either case, the vessel, in all probability, receives so much damage as to make it a matter of prudence not to incur the expense of getting her off and repairing her, even supposing it possible to be done; and the cargo, if perishable, is in all probability ruined or lost with the vessel. This is a pretty general history of shipwrecks, under the present construction of vessels.

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* Shipwrecks are distinguished from the losses of vessels by foundering, upsetting, collision, or fire.

Now, if a vessel had her timbers united, or was filled up between the timbers, and was caulked inside and out before any planking was put on,* had patent felt inside of the timbers, and her ceiling caulked, in addition to the exterior coverings of the bottom and sides, as at present, it is no error in calculation to say, she would sustain four times as much damage or violence of any kind as at present, before the water got admission into her; and before this happened, the wind and sea would, in all probability, both have fallen.

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* By the constant pressure of the masts on the keel downwards, and of the water on the outside planking upwards, when vessels are afloat, assisted too by the rigging drawing the outside planking and top timbers upwards, and both of them acting as purchases to force and draw the garboard strake out of the rabbet or groove of the keel, the only wonder is, that vessels remain so tight as they do.

By having the limber boards loose too, a vessel under the present construction gets no support from the ceiling when she is on the ground, or the limber boards do not answer the purpose they are intended for, that of letting down water from above.

In many situations where vessels get ashore on rocks, and in the neighbourhood of almost all sand banks, there is anchorage at no great distance from them. Let us, therefore, suppose a vessel constructed as above, to be ashore, and to have held together, without the water getting admission into her, until the wind and sea have both fallen. Then with a steamer or steamers, strongly constructed in the same way, and anchored in the proper place, in deeper water, with, say two or three anchors down, with cable chains, and chains attached to the vessel ashore, and capstans in the steamer, fitted to go by steam, and taking the proper time of tide, and having lightened the vessel on the rocks or bank, and applying the steam to the capstans, they would either heave the vessel off or drag her in pieces. Vessels ashore on sand banks, near the mouths of all large rivers, might thus be got off.

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* Uniting the timbers, instead of having fillings, would not only make the vessel much stronger, but would save a caulking of each filling, the whole length of the vessel, inside and out, and it would be of no consequence whether the timbers were all of the same siding, or breadth the fore and aft way, or not.

CONTRAST OF THE EXPENSE AND ADVANTAGES OF THE PRESENT, AND THE PROPOSED PLAN, IN THE CASE OF EAST INDIAMEN.

Let us suppose a 1400 ton Indiaman, ashore on the Goodwin Sands, built on this new construction, to have held out till the sea fell, and to have been got off in this manner, by one or more steamers, what would have been the expense and advantages? Let us suppose that she costs 60,000*l.* to sea, under the old construction; take half this sum as the price of the hull, and add one-third of it, as the expense of uniting the timbers, caulking, patent felt, &c. East India ships have their timbers well squared and dressed under the present construction, and, as nearly all the additional expense would be in labour, one-third the price of the hull would be quite sufficient for covering all the additional expenses. This would make the price of the vessel 70,000*l.* instead of 60,000*l.*, or 10,000*l.* more than under the old construction.

Now, let us suppose, what is most probable, that under the old construction she would have been totally lost, here is 60,000*l.* preserved, less the expense of salvage and repairs, by an outlay of 10,000*l.* The case is not yet complete, for supposing her to have had in a cargo worth 100,000*l.*, and which in the one case is preserved, but in the other is totally lost, here is 160,000*l.*, less the expense of salvage and repairs to the vessel, preserved from the sea, besides the lives on board preserved, and all for an original outlay of 10,000*l.*

After the case of the Success frigate, which has been preserved to the nation, in circumstances where no East Indiaman, or vessel whatever, without a solid bottom, could have been preserved, this is not a chimerical or fanciful case, because the same causes which preserved the Success would have preserved an East Indiaman, or any other vessel, with a solid bottom. The Success, too, would have no ceiling; and if the ceiling had been caulked in the East Indiaman, it would be one defence more than in the frigate, against the admission of water, besides strengthening the vessel.

The cargo of the Earl of Abergavenny East Indiaman, wrecked off Weymouth beach, in February, 1805, is said to have been worth 200,000*l.*, besides which she had on board dollars to the amount of 275,000 ounces; she was at least 1500 tons burthen, and built for the China trade.

Say cargo estimated at	£200,000
275,000 ounces of silver, at five shillings per ounce	68,750
value of ship, at least	60,000
Value of ship and cargo, without any allowance for property belonging to passengers and crew	£328,750

There were drowned on board of her 250 persons, including troops.

The cargo of the Prince Regent, lost in 1823, is stated in Milburn's Oriental Commerce, to have amounted to the value of	£133,623
To which add the value of the ship, say	60,000
Value of ship and cargo, as above	£193,623

To which losses, add the Cabalva, lost in 1818, the Kent, and Royal George burnt, the damage lately done to teas and merchandize, in the Reliance and Bridgewater, besides other damages not known.

There is not an East Indiaman belonging to Great Britain at this hour, which has only the external coverings of her timbers for a defence against violence, but what, in the same circumstances as the Earl of Abergavenny, would meet the same fate,—there is not a man of war belonging to Great Britain, with a solid bottom, which would; and less than 10,000*l.* would pay all the difference, and give the East Indiaman a solid bottom, and preserve the lives and property on board.

I am informed the system with the East India Company is, to take up the large ships for seven voyages, and after that only from voyage to voyage. No worse system than this could be devised, for getting strong or durable ships, because it holds out little or no inducement to build them strong; but it must be an excellent system for ship builders and surveyors, and will, perhaps, help to account for the "apathy of the first trading company in Europe." I am credibly informed, too, that Sir Robert Seppings offered gratuitously to superintend the building of an Indiaman for the Company, but his offer was not accepted. Does not this speak plainly, that it is not wished to make East Indiamen stronger than at present.

If a 1400 ton Indiaman costs 60,000*l.*,* and is taken up for only seven voyages, (about fourteen years) she must deteriorate at the rate of about 8000*l.* per voyage, and must consequently require large freights to pay for this deterioration, interest of capital, insurance, wear and tear, and all contingent expenses. Are these freights paid eventually by the public, and if so, could they not be reduced one half, by having stronger, safer, and more durable ships. This might be a consideration to tea drinkers.

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* I am informed a 1400 ton Indiaman costs above £60,000 to sea, but as this probably includes provisions and advance of wages, perhaps £60,000 is not far from the cost of the vessel, and, be it correct or incorrect, the same ratio will hold good.

REASONS WHY MERCHANT SHIPS ARE NOT BUILT STRONGER AND SAFER.

In civil and marine architecture,—in houses, warehouses, bridges, docks, quays, piers, wharfs, lighthouses, &c. strength is the first object, all others but secondary. It is difficult to conceive why it should not be so in naval architecture also.* What then can be the reason that " these improvements, (solid bottoms,) while they have been eagerly grasped by foreign nations, are but slowly introduced in the ships of our merchants; and, with an apathy hardly to be credited, are totally neglected by the first trading company in Europe?"* The answer is as plain as the question; viz. private interest, and the present system of classing merchant shipping. Although the advantages of strength and durability to vessels, and consequently safety to life and property afloat, as abstract principles, will not be disputed by any person, it yet happens that, they would be against the interests of any person connected with merchant shipping, ship owners and seamen excepted. They are clearly against the interests, not only of naval architects, ship builders, and surveyors of shipping—the first persons to whom any alterations of construction are naturally referred—but also of all tradesmen concerned in the supply of shipping to the public, from the timber merchant, mast, rope, and sail-maker, to the ship chandler, who supplies the vessel on going to sea, with a broom or a buntin needle; because the more losses, damages, or decays, of, or to vessels and their stores, the more demand there will be for reproduction, surveys, and repairs, to carry on commerce. We cannot, therefore, expect alterations of construction which would operate against their interests, to originate with, or be approved of, by these parties. It would just be expecting them to commit a *felo de se* against their interests.

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* As to the objection that solid bottoms would prevent a vessel's sailing, it may be answered that, if ships in the Royal Navy, which may be compared to race horses, are found to sail fast enough with solid bottoms, surely ships in the Mercantile Navy, which may be compared to pack horses, would sail fast enough; and as to steamers, if they do not sail or ply fast enough, put in more paddle wheels, and more machinery: we have just been legislating against their going too fast in rivers.

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* Knowles's preface.

INTERESTS OF SHIP OWNERS AND UNDERWRITERS CONSIDERED.

Ship-owners, had there been no under-writers or insurers, or classing of vessels, would long ere now have discovered and practised a method of giving greater strength and security to vessels; but I ascertained pretty correctly, when lately in London, that no plan for preventing losses of vessels at sea, or *an abandonment to the under-writers*, in cases of ship-wreck, would be countenanced, encouraged, or adopted, *even although it might be attained without additional expense*, as matters at present stand. There are exceptions to all general rules; and shipping companies, (who mostly run their own risks) and ship-owners who run their own risks, and some who do not, are an exception to the above remark. Let us see how the interest of the ship-owner is affected in general cases, under the present circumstances.

While precisely the same amount of passage-money or freight can be earned by a weak vessel, whether steamer or sailing vessel, which costs only 1000*l.*, as by a strong vessel of the same size, which costs 2000*l.*, it is evident it would be bad policy to build or purchase the higher priced vessel. Suppose them both insured to the full value, and both to get ashore; the weak vessel soon goes to pieces, and probably drowns all on board, and loses all the property on board, while the strong vessel holds together, preserves the lives and property on board, and gets off the shore. How are the interests of the owners affected? The owner of the vessel which has been totally lost receives from the under-writers 1000*l.*, less the premium and contingent expenses, while the owner of the stronger vessel, which has preserved the lives and property, has to pay his proportion, or one-third of the price of certain articles of repairs of the vessel, so that by preserving his vessel, the owner must contribute towards her repairs, and take a deteriorated, damaged, and depreciated vessel, besides the detention, loss of voyage, additional wages, and contingent expenses, and probably cannot help envying his more *unfortunate* brother owner, who has got the price of his vessel in his pocket, and probably had his freight insured also. Is this system other than holding out a premium or temptation to have weak or insecure vessels? Further, I know of no law or practice to prevent an unprincipled ship-owner, if such there be, to insure a vessel much above the marketable value of her, and even beyond what she may have cost him, and thus make money by his loss. Report speaks of such things having been done by others, besides Captain

Codling, of the Adventure, and the premium paid on the additional sum insured, beyond the value of the vessel, is but a poor protection in such circumstances. He may also insure the freight, and send her on dangerous and hazardous voyages, and thus all the chances are in his favour.

I have two vessels in memory just now, the one a weak vessel, which cost 1500*l.*, the other a strong vessel, which cost above 3000*l.* They are both of the same age, and same tonnage, and making the same freights; the same premium of insurance is charged on each, and the weak vessel will stand as long on the first class as the strong one. The owner of her, therefore, can afford to keep her insured, and if she is lost he is all right, and ready for the purchase of another, to run the same course; but the owner of the strong vessel, if he keeps her insured, (being charged the same rate of premium on double the capital,) is losing any profits his vessel may be making, in paying insurance, even in the vessel's young days; and, as she will be as soon on the second letter as the weak vessel, he cannot afford to compete with the owner of her. Hence the strongest inducement to build, or purchase cheap and weak ships. In the event of both vessels being insured, and getting ashore, and the weak vessel being lost, and the strong one preserved, the owner of the weak vessel would laugh at the owner of the strong one, for being such a simpleton as to have a strong vessel.

We can scarcely take up a newspaper, without reading of vessels putting in leaky, wrecks, and abandonments, and often the two latter, in no very trying or dangerous circumstances.

If a vessel be defective, too, and needing repairs, an average is frequently thought a good thing, as it gets a principal part of them paid by the under-writers.

It may be truly said, then, that the present system of assurance, genders, fosters, brings to maturity, and completes, the system of leaks, wrecks, and abandonments; and to prove the truth of this, let sea assurance be supposed to be done away with altogether, and see how soon the plan of having strong and safe vessels, and preserving them, like vessels in the royal navy, would be adopted.

Whatever may be the causes or motives, the fact is certain, that there is a disinclination to make steamers or sailing vessels stronger or safer than at present; and ship-owners have the ready objection, that although they were to do so, and thereby subject themselves to increased expense, they would get no higher passage-money or freights, nor reduced premiums for vessels thus strengthened and rendered safer, than they do for vessels as they at present are. This, however, remains to be proved; and I apprehend there is neither passenger, merchant, or shipper of goods of any description, who would not voluntarily consent to pay something more, to be insured having himself or his goods carried in safety, were it required; and as to the premiums, if the insurance could not be effected at a lower rate than formerly, the ship-owner might very safely take his own risk. The sums saved on insurance would soon equal or exceed the interest of the additional outlay of capital, and it would amount to the same thing to a merchant, to pay a little more freight, and the same amount less premium of insurance. A merchant would also be protected from petty damages on goods, for which he cannot at present recover, although insured, but must put up with his own loss. The fact of stronger, and better manned and navigated vessels, getting insurance effected at a lower rate, is proved by smacks compared with coasters, and thus there is an end of that objection.

Under-writers may view any alteration of construction, tending to strengthen vessels, with suspicion, seeing clearly that in whatever ratio the sea risk is diminished, the premiums will be reduced proportionally, and that many parties might then take their own risks, and cease to insure. Admitting this to be the case, I apprehend they would still be great gainers with stronger vessels and diminished premiums, as it would protect them from many a partial or total loss of vessel or goods, which they have now to bear, and which, in my opinion, the increased premiums are nowise equal to. Should they be of this opinion, and I have reason to think they will, there is no difficulty in making stronger and safer vessels. Should they entertain doubts on this head, and that they would be accepting decreased premiums without diminished risk, and if the stubborn facts of men of war, (which are made of wood, copper, and iron, the same as merchant vessels, and are in every way worse adapted for taking the ground, owing to their being built sharper in the bottom, and having their sides weakened by port-holes, and having more weight of iron ballast, guns, shot, &c. in one spot, than merchant vessels, and consequently straining the vessel more,) being daily preserved owing to their solid bottoms, in circumstances where they would formerly have been lost, (when they were built on the same construction as merchant vessels now are,) does not convince them of the diminished risk, and the additional safety of solid bottoms and sides to all vessels, let them take the opinions of naval draughtsmen, ship-builders, and surveyors of shipping, both at London and the outports; who, notwithstanding it is against their interests, are still honest men on the subject;

and if their opinion should agree with that of Sir Robert Seppings; the Committee of the House of Commons for the improvement of Steam Navigation, amongst whom were Sir George Cockburn and Admiral Adam; the Committee of Shipping of the East India Company, including the opinion of their surveyors, and of two hundred and twenty-two practical men, as I have no doubt it will, and they agree to accept diminished premiums for diminished risks, the under-writers have nothing to do but to intimate publicly that they will insure vessels with solid bottoms and sides at a lower premium than without, and the thing is done. As it could not be expected that vessels already built would be altered so far as this, let them intimate that they will make a proportional reduction to vessels with their ceilings and limber boards caulked, and, consequently, having double bottoms; and a lower premium still, to vessels filled up solid between the timbers with sound wood, in any vessel already built, and with the timbers united, and caulked inside and out, in vessels to be built, and we shall then soon see a safer set of steamers and sailing vessels, and hear of few such melancholy losses as the Comet, Frolic, Rothsay Castle, Lady Sherbrooke, &c.

ERRONEOUS CLASSIFICATION OF MERCHANT SHIPPING, AND EFFECTS THEREOF.

However presumptuous it may be in me, I cannot help thinking that the present classification of shipping is erroneous, and is the very cause of unsafe and insecure vessels. It is quite notorious to every practical and professional man, that many an E 1 vessel is stronger and better than many an A 1 vessel is, the day the A 1 vessel comes off the stocks. Yet, the A 1 vessel will get insurance effected at a lower premium than the E 1 vessel. Compare the strength of the brig Ann, of London, (belonging to Messrs. Hibbert, and built in Batavia, and which has been on the second letter these twenty-five years,) with the Brothers, of Whitby, (mentioned in foot note, page 42,) on the day the Brothers was launched, and before her timbers, made of green wood, had had time to ferment, putrefy, and rot. To have put them both on rocks, or a sand bank, side by side, with a heavy sea, the Brothers would have been in pieces before the brig Ann had well felt the bottom; and yet, the Brothers, being a first class vessel, would have got insurance done on ship or cargo at a lower rate than the Ann. Compare the strength of some of our men of war, 50 years old, with some A 1 vessels in the merchant service on the day they are launched.—" Oh, but the man of war cost a great deal more money per ton." "Very true, and you see she is still strong and sea-worthy! do you think these vessels will be so fifty years hence?" The owner might, perhaps, very candidly answer, "I hope not." I do not see the propriety of making age at all a condition in classing ships, since the veriest tool that is launched, built, probably, like the Brothers, of green wood, not squared or unbarked, and, in one word, half rotten, and the vessel herself unfit to go to sea, is never refused a register; and when inspected for the register-books, she is sure to be a fine vessel inside and out, so far as can be seen, it being then too late to inspect the timbers, on which the material strength depends, and of course she is reported A 1, at Lloyd's, and gets her insurance done at a low rate. This may be a good reason for dispensing with ceilings, like ships in the navy, or having new vessels reported on, while in frame.

The impropriety of classing vessels by age alone, seems forcibly to have appeared to the original authors of the Red Register Book of Shipping, as appears from the following extract from the explanation, at the beginning of it:— "Instead of classing the ships which they gave an account of, according to their actual state and condition, ascertained by a careful surveyor, a new system was adopted, of stamping the character of a ship wholly by her age, and the place in which she was built, without any regard to the *manner* in which she was originally constructed, the wear or damage she might have sustained, or the repairs she might from time to time have received, *or even being rebuilt;* thereby at once obviating the necessity of surveying the hulls of vessels, lessening the inducement to build ships upon principles of strength and durability, and taking away the encouragement to keep them in the best state of repair, that they might maintain their character in the Register Book alluded to." I am not aware that the practice is yet very materially departed from, and age, without further particulars of materials, or the manner they are put together, and workmanship, is so much a condition, that it operates as an inducement to build weak or insecure vessels, since parties reason, " if we build the vessel ever so strong, she will only stand her eight, ten, or twelve years on the first letter, and if we build her ever so weak or insufficient, she will do the same, therefore we had better build her as slight and cheap as possible, to last these number of years, since we have no inducement to make her stronger." Is this not the fact, and if so, does it not prove an error in the classification of shipping, in holding out an inducement to build cheap and insecure vessels; since it is notorious, that by the present classification, the strongest vessel will be reduced to the second letter, after a stated number of years, although she may then be stronger than another just launched, and that the weakest vessel built, will just stand the stated number of years, on the first letter, as well as the strongest. In spite of sophistry, if strength and safety be the objects desired, the brig Ann, although thirty-seven years old, ought to be on the first letter at this day.

Another great evil arising from making vessels stand so short a time on the first letter is, that it prevents ship-builders from being able to keep a stock of seasoned wood on hand, because a ship-owner, when he wants a vessel, cannot afford to pay for it. A ship-owner must purchase or build a vessel as cheap as his neighbour, in order to compete with him, and must just do as his neighbour does. Keep her insured, and if she is lost, all's well. Hence some vessels are built literally out of the green woods, or of timber just imported from abroad; and hence, wet rot, and dry rot, and all the ills that ships are heirs to. Hence increased risk to the underwriters, increased founderings, increased wrecks, increased loss of life, and increased damages to merchandize.*

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* See Mr. Lang's evidence before the Steam Navigation Committee, on the green wood in the Immortalite frigate.

There is no doubt, either, that a vessel with as good materials, as good workmanship, and in every way as strong and safe, might be built at any of the outports as in the river Thames. But although she were built as strong as the Success frigate, when compared with the Rothsay Castle, she would still be an outport built vessel, and stand a shorter time in the first class than a river built vessel. Hence another inducement to build weak and unsafe vessels, since parties reason very justly in saying, "we are condemned before we begin to build; and although we were to build as strong as a rock of solid granite, we cannot get her to stand so long in the first class, as if she were a river built vessel. Hence, since we are condemned without being tried, it is our interest to build as cheap as possible."

EVIDENCE OF MR. FEARNALL, MR. WM. MORGAN, AND SIR ROBERT SEPPINGS, BEFORE THE STEAM NAVIGATION COMMITTEE.

Mr. William Fearnall, ship-builder, Limehouse, London, in his evidence before the Steam Navigation Committee, says "I think it is of importance that it should be known that vessels ought to be built of sufficient strength to resist the ground, without taking damage, because it is the practice of the day at present, to get boats built (steam boats) by those that will build them cheapest, and not those who will build them best." And Mr. William Morgan, in his evidence, says "It has struck me that it would be advisable that the same kind of precautions that are taken to point out to mercantile men, who have to lade their goods, the difference that there is between the manner in which one vessel is formed and the other, in order that they may make that selection which pleases them best. Mercantile vessels are constantly surveyed and classified, and in the notes which the ship-brokers and agents circulate, they mention the class of the vessel. It serves also for the underwriter to regulate his expense of insurance, and each one knows what he has to incur. Some prefer a lesser freight, and some a larger freight. I would cause every steam vessel to be surveyed, and according as they are efficiently or inefficiently built,* they should have a

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* This is the very thing that is wanted, to determine whether a vessel is efficient or inefficiently built; but, unfortunately, a survey after a vessel is built, and planked inside and out, comes rather too late to determine that point. Vessels are surveyed by a surveyor of the customs, to ascertain their dimensions, before they obtain a certificate of registry, but it has nothing to do with the qualities or condition of them.

Nothing can be more erroneous than the present method of determining the tonnage of merchant vessels. To ascertain the solid contents of a package, length, breadth, and depth are required; but certificate of their class, and that certificate of their class should be as notorious as the circular to the shipper."

"Do you apprehend that the hulls of vessels are built with carelessness in those that go to sea, and are very often old?"—"Some are built uncommonly well, and some very loosely."

"Do you apprehend that any of them are built with carelessness?"—"I should be loth to deliver an opinion, because I have not had sufficient

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in ascertaining the register tonnage of a merchant vessel, only length and breadth are taken into account, and the depth is entirely dispensed with; so that a vessel of one hundred feet long, thirty feet broad, and ten feet deep, measures as much as if she were twenty feet deep, although it is evident if she were twenty feet deep, she would contain more than as much again of any article, because the rake at the stem and stern, and the contracting of the bottom towards the keel, would take more space from the stowage than the space occupied by the upper deck beams, supposing her, for sake of illustration, to have only one deck. Even with an additional deck and beams, it is believed her capacity for stowage would be doubled, because she must have an upper deck and beams although only ten feet deep. If she were thirty, forty, or fifty feet deep, and consequently would hold three, four, or five times as much, she would still be only of the same register tonnage, and hence the very unequal capacity of merchant vessels, in proportion to their tonnage. Hence too, for sake of carrying large cargoes, in proportion to the register tonnage, and saving dock dues, &c. vessels are built, ill-proportioned for standing up to their canvas, sailing, taking the ground, or for entering shallow harbours. While rules are given for finding the length and breadth of vessels to the greatest nicety, the depth, on which, in large vessels, hundreds of tons of contents, or space, may and do depend, is left entirely out of the calculation.

experience. I have known vessels built so very slightly, that it is not at all unlikely they should have been lost."

"Can you speak of any accidents happening to vessels arising from the slightness of the board?"—"No, I cannot. It has not excited surprise in me, that many of those steamers, or some of them, have been lost, having had an opportunity of seeing them building, but whether it has been the identical ones, which excited my observation, I cannot tell."

"Are you aware whether it is the practice, before a vessel can obtain a certificate, to be surveyed?"—"I do not know; I should imagine not, from the carcasses I have occasionally seen."

"Is your knowledge of steam-vessel building, with respect to vessels navigating rivers, or sea-going vessels?"—"More of sea-going vessels than of river-going."

And Sir Robert Seppings says, "I should think nothing would induce me to give up the filling up of the ships, because we have had important instances, where ships would have gone down, if they had not been filled in. A cutter, off the Isle of Man, lost all her stern-post, and a considerable way up what is termed the dead wood, and the bottom. We had one of our steam vessels, the African, going round to Portsmouth, got upon the Kentish Knock, carried away her keel from end to end, and a great deal of the plank at the bottom; but, nevertheless, she got round to Portsmouth, without making little if any water whatever, which was prevented by the plan I have recommended."

"Was the plank torn off?"—"Part of it, the starboard side. There are several instances of the same kind; the Gloucester had a very considerable shock in coming from the Mediterranean, in striking upon the famous rock of Gibraltar; she was very much shaken, but she made no water."

"She must have gone down if it had not been for that?"—"Yes. She made little or no water: her keel was gone."

Now, although the above evidence relates to steam vessels, there is no doubt the whole of it applies as well to sailing vessels.

Since, then, there is no difficulty in making steam and sailing vessels stronger and safer, the question arises, is it desired to do so? It is too notorious to admit of doubt, that many vessels are built with a full knowledge that they will be easily lost; and some ship-owners object to caulking their vessels' ceilings and limber boards, not so much on account of the expense, as because it would lessen their chance of getting an abandonment to the underwriters, in the event of the vessel's being stranded, or in danger, since it is almost invariably preferred, that a vessel should be totally lost, provided the passengers and crew be safe, when she gets on shore, to being got off again, even although she should be insured to only half her value; and a "sale to the underwriters," who are always considered good merchants, and sometimes get great bargains, is a common phrase.

A ship-owner cannot be blamed for this, as it is both his interest and duty to preserve his property by every just and legal means in his power; and if losing his vessel, enables him to preserve her value, he has a just right to do so; and it is the system, which holds out an encouragement to have weak vessels, which is in fault, and not the ship-owner. I think it proper to state, in order to guard as far as possible against being misunderstood, that there cannot be a doubt that ship-owners, and all persons whatever concerned with shipping, are as just, honest, upright, and conscientious as any other classes of society.

GENERAL REVIEW OF THE ADVANTAGES AND YEARLY SAVING OF PROPERTY AND LIVES, WHICH MIGHT BE EFFECTED BY GIVING MERCHANT VESSELS SOLID BOTTOMS AND SIDES.

As to the expense of strengthening vessels, let us see how the question stands, expense against risk.

PROPERTY.

Taking the data from the New Monthly Magazine, that the number of merchant vessels lost, averages at the rate of one and a half vessel per day, or 547 per annum.

Say that there might be preserved out of this number, if vessels had solid sides and bottoms, and the number is not overstated	200
The average tonnage of 2,000 vessels, taking columns in each letter of the alphabet at random from the register book of shipping, is 185 tons, without taking in East Indiamen, which would probably raise the average tonnage of shipping to 200 tons;	

but as more small vessels are lost than large, owing to their being more exposed about coasts, deduct 25 tons, or one-eighth part, will leave net tonnage, per vessel	175
Quantity of tonnage of 200 vessels lost annually	35,000
Say the value of the vessels and stores should be worth only 10*l.* a ton, multiply by 10, to bring the tonnage into pounds sterling	£350,000
Say cargoes equal to the value of the vessels. Note.—Although many of the vessels might be in ballast, yet the damages to goods in other vessels, which are not here taken into account, and losses to East Indiamen, &c. which might be prevented, would fully support or exceed 20*l.* per ton, for vessel and cargo, on 200 vessels; therefore double the price of the vessels	£700,000
Cost of preparing 35,000 tons of shipping, by giving them solid	

bottoms, &c. say even at 5*l.* per ton, or half the above amount of tonnage, which is far above what it would cost	£175,000

But this 175,000*l.* although disbursed by ship-owners in the first instance, would not be lost, and would soon save itself in premiums of insurance; failing getting which, a ship-owner might safely take his own risk, and there is little doubt of his vessel commanding a preference in seeking either passengers or a cargo, and would be the means of saving 700,000*l.* per annum, less the expense of repairs to the vessels. There is no doubt, either, that more than 200 vessels per annum, without solid bottoms, will be lost, which in precisely the same circumstances with them might be saved; and as there is no allowance made for damages to goods, it will not exceed the truth, to state the annual saving at 700,000*l.*, which will be lost in the sea, and benefit no person. How much the case is under stated, may be seen on reference to the cost of an Indiaman and her cargo.

LIVES.

Say five men and a boy to every 100 tons, or six persons to every 100 tons, as allowed in the transport service, on 35,000 tons of shipping.

This will amount to 2,100 lives of crew, besides passengers, lost in steamers, troops in transports, passengers in sailing vessels, &c. Admitting some of the passengers and crews to be saved in the above cases, the numbers lost, and which might be saved, if all vessels had solid sides and bottoms, would still exceed two thousand, and the property saved above a million per annum.

AUTHOR'S OPINION OF THE ADVANTAGES OF GIVING MERCHANT VESSELS SOLID BOTTOMS AND SIDES.

Let that portion of the public, then, who have occasion to embark in steamers or sailing vessels, and regard their own safety,—let underwriters, who are interested in saving their own property, make it an object to ship-owners to build strong vessels, no matter where,* and to preserve them, instead of, as at present, an object to lose them, and make it neither so easy nor so desirable an object to abandon, by effecting insurance on them and merchandize on board of them, at a lower premium, and according to their real and not fictitious qualities and conditions, although they should stand on the first letter for a hundred years; let merchants, interested in the safe conveyance of goods, all unite in giving a decided preference to strong vessels; and if the Commissioners of the Navy can be prevailed upon, let them also mark their sense of the improvement, by giving a decided preference to vessels with solid bottoms and sides, over vessels without, when transports or hired vessels of any kind are required; and speaking as a seaman, who has served an apprenticeship to the sea—who has navigated a ship, as master, to all the quarters of the globe —who has had some experience in superintending the building and repairs of vessels—who has also had some experience in surveying damages, both to vessels and goods—and as a surveyor of shipping, I have no hesitation in stating it to be my firm belief, that they will effect a saving of upwards of two thousand human lives annually, and upwards of a million of money per annum in merchandize, which will otherwise be lost in the sea, or damaged by water, or consumed by fire, and benefit no person. Nay, wrecks on banks, do a positive injury, as they must either be marked by buoys, to shew where they are, or they become the instruments to wreck other vessels on. Nor do I consider this to be an opinion unsupported by proof. I consider it to be proved in the cases of His Majesty's ships Wolf, Barham, Pylades, Vigilant, the cutter off the Isle of Man, mentioned by Sir Robert Seppings before the Steam Navigation Committee, as having lost her stern post and part of her dead wood; the African, government steamer; the Gloucester, as having lost her keel; the Echo, government steamer; but, above all, the Success frigate, lately returned home. With solid bottoms and sides to steamers and sailing vessels, I consider it to be beyond dispute, that more than half the vessels and lives which without them will be lost, and as they may be registered in Lloyd's List, or elsewhere, might, in precisely the same circumstances in all other respects, be saved. What hinders the adoption of them then, and the effecting of such desirable objects? It is neither the expense of making vessels stronger, nor of caulking the ceilings and limber boards of those already built; nor the interests of ship-builders, surveyors of shipping, and ship's tradesmen; nor the apprehension of the dry rot,* although all assisting; it is the present system of insurance, proceeding on the erroneous classification of shipping, positively operating in favour of weak vessels, and against strong ones.

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* It would still be proper to specify where vessels were built, as it could not be supposed that British oak would be exported to Canada, for instance, on purpose to build strong vessels.

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* That the exclusion of air from between the timbers does not produce the dry rot is proved by the experience of the Royal Navy; the case of the Lady Nelson, mentioned at page 88; the timbers placed close together opposite ships and smacks' masts, &c.; the sheathing boards under the copper, and tarred paper of coppered vessels' bottoms, from which the air is completely excluded on both sides, the doubling of vessels' sides and bottoms, &c. &c.

EXTENT OF TONNAGE IN THE MERCANTILE NAVY, &c.

The number of vessels registered in the Red Register Book for 1832, exclusive of the supplements and East Indiamen, is 15,577, and if we average these at 200 tons each, it will give 3,115,400 tons, to which if we add the supplements, tonnage of Indiamen, above 55,000 tons, tonnage of ships in India, built and registered there, and navigated by British subjects, steam vessels not registered, and omissions, it will raise the tonnage of the Mercantile Navy, to probably three millions and a quarter.

If we conceive this immense quantity of tonnage, employed in the transport of life and merchandize, and *that the strength, safety, and durability of it might be increased at a small expense*, and which expense would, in by far the majority of cases, repay itself in a short time, in insurance saved, it may appear an object of some national importance.

I can inform the labourers in the same vineyard with me, amongst whom, I believe, I may reckon Sir Robert Seppings, Mr. Knowles, Mr. Fearnall, Mr. Watson, Mr. Cadogan Williams, and those who signed the certificate of 31st May last, and to some of whom it will not be new, that so far as the great majority of Merchant Shipping is concerned, and however clearly and indisputably they may prove that tens of thousands of lives of human beings, and property worth millions of money, might be saved in steamers and sailing vessels, there is a secret and deadly influence at work, which will defeat all their endeavours, unless it be altered; viz. the present classification of Merchant Shipping, and system of insurance. So far from its being an object to a ship-owner to preserve his vessel, there are many cases, under the present system, where it is his interest that she should "melt away, and, like the baseless fabric of a vision, leave not *a wreck* behind!" The case is proved to demonstration, by a comparison of the Royal and Mercantile Navies of this country. In the Royal Navy they have no assurance to rely upon, and hence strong ships, which are preserved, in nine cases out of ten, where they would formerly have been lost, when they were built upon the same construction as Merchant Steam Vessels and Shipping now are. In the Mercantile Navy, including Steamers, they have assurance to rely upon, and hence weak vessels, which are lost, since it is a matter of indifference to the owner, so far as the value of the vessel goes, whether she be lost or not. Nay, as before said, it is in most cases to his advantage that she should be lost. This would all be very well if there were only ship-owners and under-writers concerned; but, unfortunately, there are also lives, merchandize, and property at stake. It therefore concerns not only every person who goes afloat, and has his or her life in estimation, but every person who does not go afloat, that steamers and merchant vessels should be made stronger and safer, since all sea insurance is neither more nor less than a tax on sea-borne articles. Let, for instance, a hundred colliers, laden with coals for London, be lost, and it will not only raise the price of coals at London, but also in the country; nor does the rise of price end with the immediate loss. A higher rate of insurance will be demanded, to cover similar risks, and hence a tax on the article in perpetuity, which must be paid by the consumer. It is similar with all other articles, and forms the foundation for an unnecessary tax.

A few more such losses as the Comet, Frolic, and Rothsay Castle steamers,—the Lord Melville and Czar smacks,—the Berwick smack and British Queen, mentioned in Captain Martin's letter to the Steam Navigation Committee—the Carn Brea Castle, the Lady Sherbrooke, Trusty, Rover, and thousands of others whose names I do not know, and many where no individual has been spared to tell the tale; besides the horrible accounts of survivors of vessels water-logged in the North Seas, who have been compelled to support life on each other's bodies,—the Hindostan, Earl of Abergavenny, Cabalva, Prince Regent, Kent, and Royal George, East Indiamen,—and we are in a very fair way for similar disasters and calamities,—and it is to be hoped the national attention will be roused, to consider whether the "dangers and accidents of the seas," may not be diminished by one half, and whether we are not at present under the influence of an artificial system, which very much tends to increase them.

Under-writers may say, but how are we to ascertain the real qualities and conditions of vessels, whether with solid sides and bottoms or without them. I have already said that it is preventive measures which are wanted, and not remedial ones, since all remedial measures come too late, and although we cannot remedy the evil altogether in vessels already built, we may go far to prevent it in vessels to be built.

COMPARISON BETWEEN STEAMERS AND MERCHANT SHIPPING, AND STAGE COACHES AND WAGGONS.

Merchant steamers and merchant vessels, including East Indiamen, may not inappositely be compared to stage coaches and stage waggons. The one set carry passengers and goods on the water for hire, the other set on the land. Now it would not be tolerated that the proprietor of a stage coach or waggon should have an unsafe vehicle, to break down and risk the necks and limbs of His Majesty's subjects, and lose the property committed to his charge, when the method of making a stronger and safer vessel was known and pointed out to him; nor would it be received as any exculpation, that a vehicle on the improved construction would cost him a sixth part more of price, or even a half, or even double the price; far less would it be allowed him to plead in justification, that his vehicle, although unsafe, was insured by a person who in all probability had never seen it, like the majority of cases where shipping is insured, and that, so far as his pocket was concerned, it was his interest to have a cheap and insecure vehicle, instead of a strong and safe one. So far the comparison between steamers and merchant shipping, and stage coaches and waggons, holds good, except that the vessels, instead of breaking the necks and limbs of the passengers, drown them; but there it ceases, because the proprietor of a stage coach or waggon does not insure it, and thence it becomes his interest to have a strong and safe vehicle, and which he procures accordingly. The same causes would produce precisely the same effects in shipping.

The root, origin, and real efficient cause, therefore, of the present unsafe state of steamers and merchant shipping, and consequent drownings and loss of property, is the system of insurance;* and hence the article quoted from the Edinburgh Encyclopedia;† the pamphlet written by Sir

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* Millions of money paid or transferred from one hand to another, as insurance, in insurance brokers' officers, or banks, would not have preserved the Earl of Abergavenny East Indiamen, but less than ten thousand pounds, expended in giving her a solid bottom, would have preserved her, and all the lives and property which were lost in her. Solid bottoms would have preserved the lives which were lost in the Comet, Frolic, and Rothsay Castle, steamers, and, in similar circumstances, all other things being precisely the same, solid bottoms and sides, (stringers, cross laid decks, &c. excepted,) would prevent such losses in future.

† I am informed by Dr. Brewster that the Emperor of Russia has sent to Mr. Harvey, the author of this article, "a magnificent diamond ring, as a testimony of gratitude for the valuable investigations published in that article."

It would appear thereby, that Russia is paying some attention to the improvement of the construction of her martial and commercial marine, and Great Britain will probably, some half century hence, be forced to adopt the very plan which we have taught her and other nations, and which we have allowed them to be the first to put in practice.

Robert Seppings, and read before the Royal Society, March 9, 1820, and published in the Philosophical Transactions, "On a New Principle of Constructing Ships in the Mercantile Navy;" the papers written, and lectures delivered at the Royal Institution, by Mr. Knowles, &c.; all proving incontrovertibly that merchant ships might be built stronger, safer, and more durable, at a small expense, are, nevertheless, disregarded, because, on account of the insurance, there exists no cordial desire to make them stronger and safer.

CASES IN POINT, IN MERCHANT VESSELS WHICH ARE NOT INSURED BEING STRONGLY BUILT, WITH DISTANCES BETWEEN THE TIMBERS, &c.

I have never seen a finer body of timber in any merchant vessel, than there is in the Royal Sovereign and Duke of Buccleugh smacks, built by Robert Menzies and Sons, ship-builders, Leith, who are also building the Royal Adelaide steamer, referred to.

These smacks ply between Leith and London, and are not insured, and thus give another proof, that the public safety is thereby more attended to, and it is from companies like those, to which these vessels and the Royal Adelaide belong, who run their own risks, that we are to look for the first adoption of an improved method of construction.

As a very general misconception prevails on the distance which the timbers of vessels are apart, or separate from each other near the keel, supposing it to be greater than it really is, I have to remark that it does not in general, exceed upon the average, three inches in a well built vessel; and that in a vessel of about 340 tons, lately built by Messrs. Menzies and Sons, for public sale, at Leith, the vacant spaces between the timbers at the heels, or lower ends of the first futtocks, and filling in timbers, &c. did not average three inches from end to end of the vessel. This was a faithful well built ship under the present construction.

HOW THE STRENGTH OF MERCHANT VESSELS SHOULD BE ASCERTAINED AND DETERMINED.

There is an excellent letter in the Report by the Steam Navigation Committee, from Mr. Sparrow, surveyor, to Lord Viscount Melbourne, dated Custom-house, Holyhead, 3d September, 1831, in which he most judiciously suggests, that an Act of Parliament should be obtained for all vessels carrying passengers, to the following effect: "That the builder shall, in the first instance, extend his certificate, by inserting therein the scantling of the ship's keel, floor, futtock, top timbers, &c. with a description of her fastenings, which shall be reiterated by the Surveying officer of the Customs, in his certificate, with the addition, if such ship is intended to be employed in the conveyance of passengers, that the scantling of her timbers, and the description of her fastenings, are of the size and strength required (by such an Act of Parliament) according to her tonnage."

SUGGESTION SHOULD BE FOLLOWED UP, AND ACT OF PARLIAMENT OBTAINED.

Nothing could be more judicious or proper than such an Act, and my only objection to it is, that it does not go far enough. Instead of restricting it to vessels carrying passengers, it ought to be made general to all vessels, and a survey ought to begin at an earlier period, seeing that when a vessel is closed in, it is too late to see her timbers, on which the principal strength depends.

Let the underwriters, then, apply for an Act of Parliament, in which they will be seconded by the whole public, who are interested in saving life and property afloat, to make it imperative on ship-builders, under penalty of not getting a register, to apply to the Surveying Officer of the Custom-house where the vessel is to be registered, and also the Surveyor of Shipping, commonly called Lloyd's Surveyor, of the district, to inspect the vessel, when she is rammed or framed, and before any planking is put on her, inside or out, and take the particulars of the depth and thickness of the keel, kelson, timbers at various parts of the fabric, stem, stern post, &c. all which might be done in a tabular form, with little trouble, and at no expense to the builder, and also the kind of wood the various parts are composed of, and whether it be well or ill seasoned, and free from sap-wood, (the mother of the dry rot), knots, or defects, also the form of structure, and whether the timbers are wide apart, or close together, or united, with the fastenings, and their sizes; all which particulars to be entered in a book for the purpose, at the time, and on the spot. A second survey to be held, and the particulars taken, when the vessel is fully timbered, and before she is closed in; and a third when she is launched and completed. The Surveyor of the Custom's book to be kept where the vessel is registered, and the Surveyor of Shipping, who should be appointed by the Underwriters, (the same surveyors as at present are the best and most competent) and who would really then be the Surveyor for Lloyd's, should transmit his book, whenever any vessel is launched, to Lloyd's, to be open to the inspection of all concerned. All the above particulars to be compared, and inserted in the ship-builder's and Surveyor of the Custom's certificate, and in the ship's license, as suggested by Mr. Sparrow, and they would thus become always accessible evidence of the built and strength of the vessel.

SURVEY ON THE REMAINS OF THE ROTHSAY CASTLE, WITH REMARKS THEREON, AND NECESSITY OF SURVEYS.

A survey on the shattered remains of the hull of the steam packet Rothsay Castle, now at Conway, viz. :—

Outside Planks, thickness as under.

Deal planks			1½ inch.
Ditto			1¾ to 2 inch.
1 American Birch			2½ inch, with spikes.
Top timbers	3½ to 4½,	which ought to be	4½ to 5½ inch.
2nd Futtock	4½ to 5,	“ “	5½ to 6½ inch.
1 Futtock head	5,	“ “	7½ inch.

Few new top timbers fastened with iron spikes, bolts in the inside binding strake ⅝ of an inch, planks 3 inch.

(Signed) Robert Roberts.

The above-named Robert Roberts, ship-carpenter, of Conway, deposes upon oath, before me, John Owen, clerk, one of His Majesty's Justices of the Peace, for the county of Carnarvon, that to the best of his judgment, the timbers above specified were much too light for a vessel of the tonnage of the Rothsay Castle.

(Signed) Robert Roberts.

Sworn before me, this 26th day of August, 1831.

(Signed) John Owen.

And William Jones and Robert Owen, ship-carpenters, depose, That the vessel appeared to them to have been very slightly built; and that, in their opinion, neither her new nor old timbers were strong enough for a vessel of a larger burthen than from forty to fifty tons. And also, that had all her timbers been in a sound state, they would have been much too weak for her size and engine.

(Signed) William Jones.

The mark of
✕
(Signed) Robert Owen.

Witness, John Griffith.

PREMIUMS OF INSURANCE SHOULD BE REGULATED BY STRENGTH OF VESSELS, AND REASONS WHY AN ACT OF PARLIAMENT WOULD NOT BE OBJECTED TO.

Underwriters will see from this description what sort of vessels they take risks upon; and if such an Act of Parliament as I have shortly described were obtained, and the proper dimensions and scantlings of the timbers, according to tonnage, were got from the master builders of the king's yards, who can have no interest but for the general welfare of the country, it would completely put a stop to such craft, whether steam or sailing, being built, and of which there are dozens running just now, and be the means of saving hundreds of lives, and much property, which will otherwise be lost; for it must be observed, that the owner of the Rothsay Castle cannot be blamed for the insufficiency of the dimensions of her timbers.

There appears from Mr. Coxhead's evidence, to be something mysterious about the loss of the vessel; and it seems strange that it did not occur to the crew to bale the water out of her, when the pumps got choaked, and in doing which it appears they would have been cheerfully assisted by the passengers. What could be the reason for the Captain refusing to quit the deck for a moment, to see the water in the cabin, and for his making a signal to the steward, a full hour before the vessel struck, that all was lost?

Surveys as above described will do more good in preventing losses of vessels, than fifty surveys after the vessel is closed in and launched; and as the premiums of insurance should be regulated by this book at Lloyd's, it would hold out an inducement to ship-owners to build strong vessels, no matter where, and enable ship-builders to keep a stock of seasoned wood on hand, when ship-owners could afford to pay for it.

No ship-owner, building his own vessel, could object to such an act, because the vessel might pass into other hands, and it must be his interest to shew that she was a faithful well-built vessel; no ship-builder, building a vessel for sale, could object to it, because it must be his interest to prove to a purchaser, by the intervention of honourable men, and neutral parties, that the vessel was well and faithfully built; and if any ship-builder or ship-owner did object to it, it could only be from the very worst of motives, and is the very reason why it should be passed.

CONCLUDING REMARKS AS TO FOREIGN NATIONS ADOPTING IMPROVEMENTS IN SHIPPING.

The Americans convinced us of the practical application of steam to naval purposes, after it had been condemned and discountenanced here, (because it interfered with the interests of parties,) and still dispute the honour of the invention with us; it is to be hoped then, that we will not, for the sake of keeping up a false and fictitious system of classing shipping, which benefits no person, and sacrifices the property in the sea, permit them, the French, Russians, and other nations, to shew us an improved construction of merchant shipping, and practically to convince us that "the preponderance of trade, is preserved, not by enterprise only, but by conducting commerce in the most efficient manner, and on the most economical principles," since, besides the lives lost, all expenses must come at last out of the pockets of the consumer.

EXHIBITION OF PROPOSED PLAN, MODELS AND DRAWINGS, AT LONDON, AND RECEPTION THEY MET WITH FROM PARTIES INTERESTED IN MERCHANT SHIPPING.

Should any person doubt the effect of the percolators, a rude model of them, on a working scale, together with a drawing of them, may be seen and tried, on application to Mr. William Morgan, at Hore's Wharf, Hermitage Bridge, London.

It is also due to myself to state that, when I was in London, in October last, I offered to submit the plans, models, specifications, and drawings, with such explanations as I could give respecting them, to Lloyd's, the Committees for conducting the two Register Books of Shipping, the Ship-Owners' Society of London, and the Royal Sailing Society, *free of any expense*, and they all declined to inspect them, excepting the Committee for conducting the Red Register Book of Shipping, who declined to express an opinion respecting them; and I received an apology from the Secretary to the Royal Sailing Society, stating that in consequence of the prorogation of Parliament, he could not get a Committee Meeting collected together, much as he was anxious for it, and had used his best endeavours to effect.

Some people have been bold enough to think, that so far as our Commercial and Steam Navy is concerned, this argues, "a rotten plank in the state of Denmark."

AUTHOR'S EVIDENCE BEFORE A COMMITTEE OF THE HOUSE OF COMMONS, SITTING ON THE IMPROVEMENT OF STEAM NAVIGATION, WITH INDEX TO DITTO.

HOUSE OF COMMONS,

Committee (Select) Steam Navigation.

Mercurii, 28° die Septembris, 1831.

Colonel Sibthorp in the Chair.

Ordered,

That Mr. J. Ballingall, (52, Wellclose Square,) do attend this Committee to-morrow, (Thursday,) at 12 o'Clock.

(Signed) **Robert Sibthorp.**

(House of Commons),
Jovis, 29° *die Septembris*, 1831.

Mr. James Ballingall called in; and Examined.

[The Witness produced various models for the improvement of all vessels, with regard to safety, durability, and protection to cargo from fire and water, in case of accidents at sea, which were examined by the Committee, and so far as they were inspected, were approved of.]

2335. You have been accustomed to the sea, have you not?—Yes; I am a seaman.

2336. Are you a ship-builder?—No.

2337. Are you accustomed to steam-boats; have you had any considerable opportunities of observing their construction and defects?—As a passenger I have.

2338. In what particular situations principally?—Principally on the Firth of Forth.

2339. Is it your opinion that steam-boats are generally built with sufficient attention to strength and public security?—Most unquestionably not.

2340. Do you remember any particular instances in which accidents have happened from neglecting those points?—I do not recollect instances where there have been actual losses, except the Rothsay Castle and the Frolic; not cases certainly which have come under my own cognizance, but which I have seen, from the public papers, to be particularly defective.

2341. Are you of opinion that it is desirable for the public protection that some measures should be adopted to insure their construction with more strength, and greater attention to public security?—Yes I am.

2342. Do the models which you have now exhibited, and the modes you propose, arise from your having observed that steam-boats are defective at present?—They do so. I have no object in presenting those models but to make them public.

2343. Have you built any vessel upon this principle?—No, I have not.

2344. Have you any thing else to state to the Committee which you think would be useful for them to know, to promote the object they have in view, which is to prevent danger to the public from steam-boats?—There is nothing which I can suggest further than the necessity of having periodical surveys of all steam vessels. I consider it should be enacted, "that all steamers should be filled in solid in their bottoms and sides, to above the line of load-water floatation;" that were the Commissioners of the Navy to announce publicly, in any manner they might think proper, "that having had 21 years' experience of the beneficial effects of solid bottoms in the ships of His Majesty's Navy, in point of strength and safety, they would give a preference to vessels with solid bottoms, when steamers, transports, or hired vessels of any description, were required;" it would have a beneficial effect.

2345. You, as a practical man and part-owner and manager of a shipping company, which carry on a considerable trade, see no inconvenience in such regulations being made?—None whatever, I think they would be beneficial to the public.

2346. Do not you think it would give confidence to the service?—Yes, I think it would do good to steamers.

2347. Do you see any difficulty in that being done by the collector of the customs employing persons at any port?—None whatever.

2348. Do you consider that the expense would be a burthen?—I think the expense would be cheerfully paid, even by the owners of steam-boats, though the policy of the owners paying might be exceedingly questionable.

2349. How would that, in your opinion, be effectually done where there was not an opportunity of having a regular surveyor; for instance, in some of the inland towns; can you suggest any way in which the person appointed might obtain any tolerable information; supposing, for instance, it were a carpenter?—It is a question whether he might be of sufficient rank to be beyond partial influence; but I would suppose some such person as an officer of the Navy; any body who knows any thing of steam-boats can easily see when they strain.

Ballingall, James. (Analysis of his evidence.)—Insufficiency of strength and public security in the general build of steam vessels, 2339—Models

made by witness, and presented to the Committee, in consequence of the defective state of steam vessels, 2342—Suggestions for prevention of danger; that periodical surveys should be made; that steamers should be filled in solid, that the Commissioners of the Navy should announce their preference to vessels with solid bottoms for transports, 2344—Such regulations would be beneficial to the public, and give confidence to the service, 2345, 2346—Method of carrying them into effect, 2347, 2349—Expense of survey by whom to be paid, 2348.

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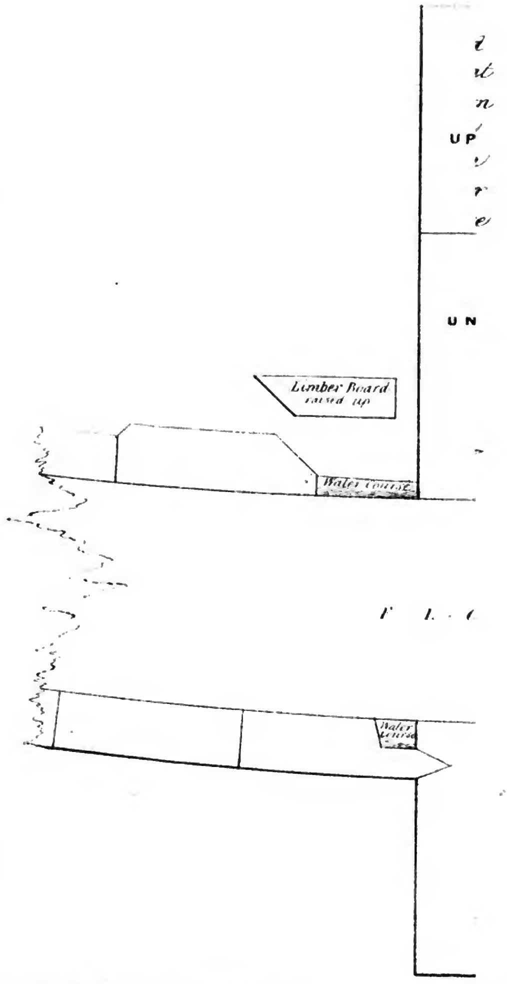

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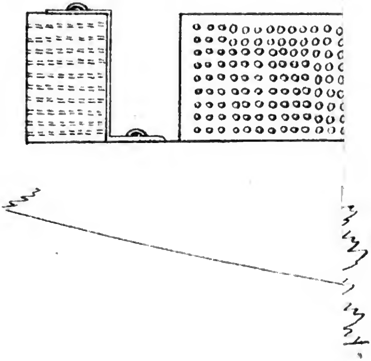

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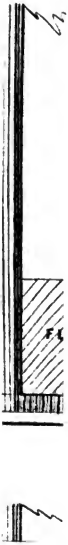

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PLATE 5.

Sketch of part of a Longitudinal Section of a Merchant Ship as now built; representing the Floor Timbers and inside edge of the Garboard Strake cut off to a line perpendicular with the outer edge of the Keel, at which place half the thickness of the Garboard Strake is rebated away to form a Water Course under the Floor Timbers, leaving only a substance of 1½ inches as shewn at A to protect the Ship from all the accidents to which she is liable.

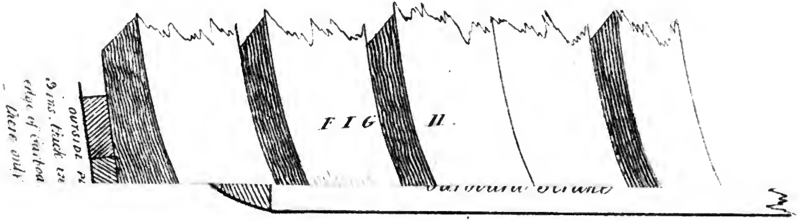

FIG. II.

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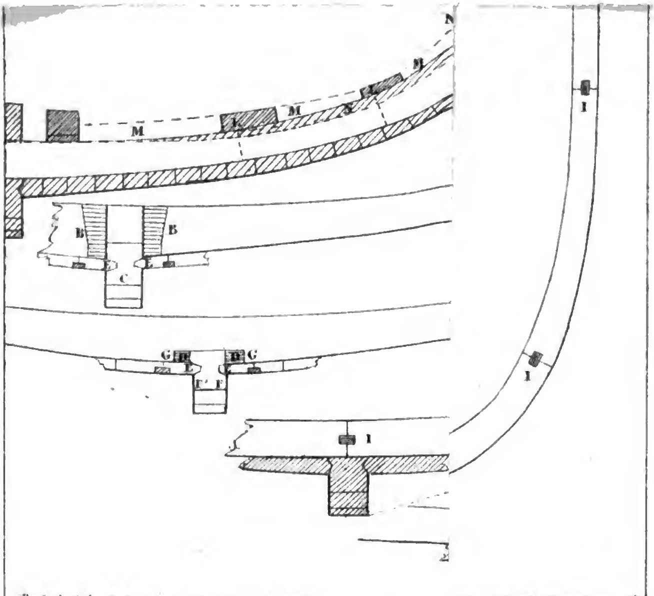

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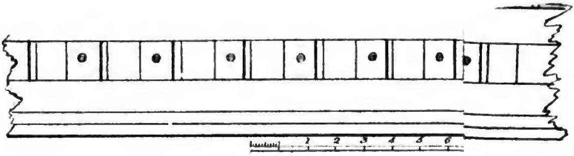

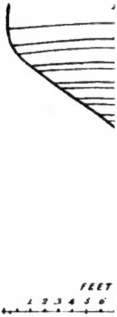

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